Section 1. Introduction

The Source Water Assessment Program, or SWAP, was established by the 1996 Amendments to the federal Safe Drinking Water Act (SDWA), specifically by the addition of Section 1453 of that Act. Its stated purpose is to assess the threats to our sources of drinking water, "for the protection and benefit of public water systems, and to support monitoring flexibility". In Rhode Island, the Office of Drinking Water Quality in the Department of Health has the responsibility of producing these assessments, and will provide them to the suppliers and general public.

The Office of Drinking Water Quality regularly inspects all Public Water Systems (PWSs) to ensure that the water delivered to the public meets all of the standards set by the US EPA. Rhode Island has had very high quality water over the years, but contamination has occurred, from time to time, from the sources addressed in the Source Water Assessment Program. The goal of the SWAP is to assess the susceptibility of water sources to contamination by the substances and microbes regulated under the Safe Drinking Water Act, as well as certain threats for which regulation is being considered.

It is generally recognized that protecting the quality of drinking water is cheaper than treating water after it has been contaminated, and more certain than seeking new sources. The SWA Program is intended to make suppliers, developers, planners and consumers aware of the threats to the future quality of our water, so that we may take action before contamination occurs.

There are four basic requirements of the SWAP:

- The first step is to delineate the area from which a source receives its water. This is called the recharge area, and is designated as the Source Water Protection Area, or SWPA. For surface water supplies, it is that portion of the watershed which is upgradient (uphill) from the water supply intake; for wells, it is an area around the wellhead that recharges groundwater, referred to as the Wellhead Protection Area.
- The second step is to inventory all potential sources of contamination to the water supply within the SWPA. These are land uses that use, store, or generate chemicals or microbes that are regulated under the federal Safe Drinking Water Act, and include everything from industries to residences. See Table 6 for a list of the contaminants of concern.
- The third step is to assess the risk associated with each potential source of contamination, and to rank the threats within each protection area. The overall susceptibility of the water source will also `be evaluated.
- The last step is to make the results of the assessments known to the suppliers and consumers of public water, as well as to town planners, developers and others with an interest in the long-term quality of our drinking water supplies.

The goal of the SWAP is to encourage and enable effective protection of drinking water sources. There are many benefits to the public from the Source Water Assessment Program.

- It will further our understanding of the threats to our drinking water supplies, and allow State officials, town planners and water suppliers to take appropriate action to protect these supplies.

- As mentioned above, it will support monitoring flexibility. Based on the results of an Assessment, the State can grant monitoring waivers to a supplier for specific contaminants that are not found within the SWPA. This can amount to savings of several hundred dollars per year for each system that receives waivers. The actual amount depends on the specific testing requirements that may be waived. The State can also use Assessment results to target additional monitoring for supplies at risk, and many agencies may use the rankings to target grant money for pollution prevention programs to the systems found to be most at risk.
- Since public involvement is strongly encouraged, more people will become involved in protecting their watersheds and ground water supplies. It is recognized that residential use of pesticides and fertilizers, not to mention residential wastewater, represent significant threats to our water quality. Individual action and political action can lead to long-term protection of our water supplies.
- Ancillary benefits include the field verification of various databases, and the creation of digital data-collection formats that will allow easy modifications and updating as better information becomes available and land uses change through the years.

A great deal of work in the area of Source Water Assessment has already been done, as outlined in Section 2, Existing Programs. The SWAP will not duplicate these, but will rather build upon them and consolidate their information into a more useful format for future protection efforts.

The State's Source Water Assessment Plan was submitted to EPA on 6 February 1999, as required by law. EPA has nine months from that date to review, suggest amendments, and approve the Plan. Assessments must be completed within two years of EPA's approval of the State's Plan. The State can request an 18 month extension, and EPA has indicated an extension will be granted if requested with appropriate justification. Rhode Island plans to request such an extension, since we have many sources of drinking water in highly developed areas that will require an in-depth inventory and assessment effort, and since the state intends to make maximum use of public input in the inventory and outreach phases. This is discussed more fully in Section 5, Public Participation.

Section 2. Background and Existing Programs

Public water suppliers are those systems that have at least 15 service connections, or that serve at least 25 people per day for at least 60 days of the year. They fall into four categories:

- Large community water suppliers are those that pump at least 50 million gallons per year. There are 16 systems of this size.
- Small community water suppliers (69 systems) serve residential customers but pump less than 50 million gallons per year. Examples would be trailer parks, small residential communities, and nursing homes.
- Non-transient non-community water suppliers (74 systems) serve at least twenty-five of the same people for at least 60 days of the year. This group includes schools and factories.
- Transient non-community suppliers (330 systems) serve at least twenty-five

different people at least 60 days of the year. Hotels, campgrounds and restaurants fall into this category.

Rhode Islanders are supplied with drinking water from both surface reservoirs and groundwater aquifers. Four hundred eighty-nine systems draw water from over six hundred wells and 22 reservoirs. Scituate Reservoir, managed by the Providence Water Supply Board, provides water for over two-thirds of the state's population through direct service and sales to other systems.

There are several drinking water protection programs currently administered by various state departments and agencies, and other levels of government. A brief review of the major efforts is given here.

The Rhode Island Department of Health is responsible for enforcing the provisions of the federal Safe Drinking Water Act (SDWA). This includes both extensive water testing program and inspections of public water supply facilities. Inspections involve both the water supply and the treatment and distribution systems. A detailed inventory is conducted within the inner protective radius (see Delineation section), and the integrity of the wellhead or surface water intake is assessed. Suppliers are required to control only the inner protective radius; protection for the rest of the SWPA can most effectively be addressed at the municipality level.

The state has the authority to grant monitoring relief to systems that qualify. This can save systems hundreds of dollars per year in testing fees. Waivers are granted on the basis of land use within the Source Water Protection Area and on a history of negative test results.

An inventory project was initiated in 1995 for the purposes of promoting wellhead protection and granting monitoring relief (waivers). Inventories were performed for many of the State's Non-Transient Non-Community (NTNC) and small community systems under a joint effort of the Office of Drinking Water Quality and DEM's Office of Water Resources.

These inventory files include lot-by-lot inventories along with historical land use information, chemicals associated with the various land uses, and a detailed discussion of topography and soil types. Monitoring waivers were granted based on the results of the inventories; the presence of a contaminant precluded a waiver. Systems that were immediately found to be ineligible for testing waivers did not receive thorough inventories. Most of these have been inventoried under the Wellhead Protection Program; those few systems that have not been inventoried will be flagged for special attention under the SWA Program. New water sources that have been approved since the Waiver Program have been required to include a land use inventory within a default Source Water Protection Area with their initial public water system license applications, and after an initial round of testing, they may be granted waivers.

Waivers must be renewed for each three-year monitoring period. The next renewal would be due in January of 1999, but the State will automatically extend existing testing waivers pending completed Source Water Assessments. Waivers for the period 2002 - 2004 will then be granted based on the SWA's.

The Atlantic States Rural Water and Wastewater Association (ASRWWA) is currently writing Wellhead Protection Plans for small Community systems. Their efforts are based on the Wellhead Protection Program discussed below. Their field representative is under contract to produce thirteen Wellhead Protection Plans per year in Connecticut and Rhode Island. ASRWWA also assists PWSs in applying for monitoring waivers under the program discussed above. The Department of Health will coordinate with ASRWWA to address those systems considered to be most at risk for more intensive assessment effort.

The Rhode Island Water Resources Board (RI WRB) deals with the largest Community Public Water Suppliers, which are systems producing over 50 million gallons per year (mgy). There are sixteen of these in the State, including all but two of the surface water suppliers (see Appendix 4).

- They have been required to file Water Quality Protection Plans with the WRB every five years. Risks related to land use are discussed in these plans, as are priorities for water quality protection efforts. The WQPP's have been superceded (as of January 1999) by Water Supply System Management Plans (WSSMP), which are required to include a Source Water Assessment. The initial Source Water Assessment for each system will be prepared by the Department of Health in conjunction with the URI Cooperative Extension, as detailed in this plan.
- Money is made available (from a surcharge on water sold) to large suppliers for the outright purchase of, or purchase of development rights to, properties deemed critical to protecting drinking water quality. Suppliers' plans for drinking water protection through acquisition are detailed in their Water Quality Protection Plans, and will be included in their WSSMPs.

The Department of Environmental Management's Office of Water Resources administers the State's EPA-approved Wellhead Protection Program (WHPP). Under that program, all groundwater systems have received at least an initial Wellhead Protection Area (WHPA) delineation, and most WHPA's have been inventoried for potential sources of contamination (see Appendix 7).

In addition, either the supplier or the municipality must develop a Wellhead Protection Plan that identifies groundwater protection strategies within the WHPA. As of the publication of the 1997 WHPP Biennial Report, eight plans out of 41 required had been approved. It is anticipated that the Source Water Assessment Program will add momentum to this effort through its inventory and assessment activities. When the assessments for a town or system are complete, they will be included with the WHPP for that town or system.

The Office of Water Resources also administers the state's Underground Injection Control (UIC) Program. This program is developing a database of facilities that currently use UIC Class V wells to dispose of waste through underground injection. The program has identified drinking water source protection areas as their highest priority, and has agreed to share its database with the Department of Health. In addition, any UIC data gathered as a result of SWAP inventory efforts will be forwarded to the UIC office.

The Division of Agriculture at DEM has developed a State Pesticides

Management Plan. It addresses protecting drinking water sources from contamination from pesticides. The State's Pesticides Management Program conducts outreach with both farmers and residential pesticide users to reduce environmental risks associated with pesticides and fertilizers.

The United States Geological Survey has done a statistical analysis of susceptibility to contamination among Community and NTNC wells. Detection of contamination was correlated with characteristics of the wells, land uses, and geology in the Wellhead Protection Areas. Results of this study will serve as the basis for assigning relative susceptibility levels to all wells. An abstract of the study is included as Appendix 5. (Note: in the study, "vulnerability" is defined in terms that make it more nearly "susceptibility" as used in EPA's SWAP guidance document.)

- USGS also maintains stream gauges around the State, as well as groundwater monitoring wells. They have published many reports on the various aquifers and surface water bodies in the State and are currently engaged in several other water-related studies in concert with various state, federal and local entities.
- The Department of Health will also contract with USGS to refine the delineation of some Wellhead Protection Areas in the State. Much of the groundwater modeling has already been done, and proposals are being submitted to complete the work. This issue is discussed under the Delineation section of this plan.

The University of Rhode Island's Cooperative Extension Service has developed the MANAGE Program, a decision support tool that identifies land use, soil type, average rainfall, and other factors to predict nutrient loading to both ground and surface waters. The program involves the local community in updating land use information. Local involvement gives protection efforts based on the results broad public support. The program has already been applied to several watersheds and aquifers in the State. It is the intent of the Department of Health to contract with URI to apply a modified version of the MANAGE Program to the SWPA's of the state's largest water suppliers. See Appendix 10 for a synopsis of MANAGE.

In addition to the programs outlined above, many studies which address specific systems, water bodies, or aquifers have been conducted over the years by suppliers, USGS, URI, DEM and others. Every attempt will be made to incorporate as much existing data as possible into each system's Source Water Assessment.

Section 3. Development of the Source Water Assessment Plan

In the Guidance provided by EPA, emphasis is placed on public participation in developing the Source Water Assessment Plan. The Office of Drinking Water Quality determined that two committees should be formed. One committee represented the technical expertise available in the State, and addressed the more technical aspects of assessing the threats to drinking water. The other was made up of a more general cross-section of the public at large, and was charged with advising the Department on matters pertaining to public

involvement and utility of the assessments. At the request of the Public Advisory Committee, notice of all meetings was sent to members of both committees, and all were welcome to attend.

Public Advisory Committee

Letters were sent to a list of people whose participation in earlier committees indicated their interest (see Appendix 2). Every effort was made to make the group representative of the widest diversity of interests. Each addressee received a brief survey, asking their preference of meeting locations and times and a request for suggestions for additional members of the committee. Letters were sent to the groups and individuals that were suggested.

Most groups responded in a timely fashion. Those that did not were contacted by telephone when possible. Some groups indicated that they did not have the time or resources to participate, but expressed an interest in being kept abreast of developments. These groups were sent copies of minutes and agendas, and promised to respond via mail or in person if they feel they could add to the discussion. The final group numbered 14 at the first meeting, and showed a fair diversity of interests.

Certain groups were not represented. In particular, town government was noticeably absent. Letters were subsequently sent to all town planners (list obtained from the RI League of Cities and Towns) whose municipalities were required (under the Wellhead Protection Program) to develop WHP Plans. The letter informed the planners of the essence of the SWAP and gave contact information. Several called the Office for more information. Also, an item was placed in the New England Planning Journal to inform their membership of the SWAP Program in RI and Massachusetts.

The final Committee membership varied, as more groups responded and others left the group. A summary of the Public Advisory Committee's concerns is attached as Appendix 2. Individuals and groups represented are also listed.

At the request of the Public Advisory Committee, a subcommittee was formed to develop outreach mechanisms. It was suggested in that committee that the State host public informational sessions, with non-profit groups or State agencies supplying the venue, outreach, and participants. These meetings could be held at locations around the State, and in a less formal atmosphere than a public hearing. The goals of this type of meeting would be to inform the public about the SWAP and to solicit their feedback concerning the format for the final Assessments as they are to be made available to the public. These meetings would ideally be held at least once in each county or region of the State, with follow-up meetings possible if the participants thought it worthwhile. Meetings were planned and held at three locations around the State: one in Pawtucket, one in South Kingstown, and one in Portsmouth.

A web site specific to the Source Water Assessment Program can be found at www.health.state.ri.us/environment/swaphome.htm. The site carries background information, links to relevant sites (e. g. EPA's Office of Ground Water and Drinking Water, US Geological Survey, American Water Works Association (AWWA), RI DEM, and URI's Cooperative Extension Program), lists of Committee members, and agendas and minutes from all meetings. An E-mail address

appears as a link (library@health.state.ri.us) so that people can respond to material appearing on the web site.

The Public Advisory Committee's main concern was that the State should undertake adequate outreach to involve and inform the public of the process and the results of the SWAP. The Committee itself addressed this, as follows:

- Three regional meetings have been held, to inform the public and solicit input on the Submittal, as detailed above. Despite extensive outreach coordinated by the Public Advisory Committee, turnout was low. This seems to be consistent with the experience of other States.
- In addition, further meetings will be scheduled on a town-by-town basis as the Assessments progress (see Assessment section).

A paraphrased list of the questions suggested in EPA's guidance document was distributed to the committee members, and is included in Appendix 2. The main suggestion resulting was to offer condensed versions of the larger SWA's to make them more readable and cheaper to distribute.

Technical Advisory Committee

The Technical Advisory Committee was assembled from the various levels of government involved in drinking water protection (see Appendix 3). The RI Departments of Health and Environmental Management, the United States Geological Survey and Environmental Protection Agency, the RI Public Utilities Commission and Water Resources Board, the Providence Water Supply Board, and the URI Cooperative Extension were all represented. Later in the process, the City of Newport Water Department joined the Committee.

The committee members each gave a presentation on the work that their organization does in the realm of Source Water Assessment and protection. It was found that there were many complementary activities being pursued by different groups; indeed, the first benefit of the program was the exchange of ideas, critiques and data among committee members. A summary of the group's activities is attached as Appendix 3.

The areas identified by the Technical Committee that need attention were the following:

- Refinement of certain SWPAs. Criteria were agreed upon for choosing SWPA's for refinement (see Delineation, Section 4). A subcommittee applied those criteria and selected a list of recharge areas for refinement.
- Choosing assessment methods that are cost-appropriate and expeditious.
- Identifying which types of systems required different levels of effort. This discussion resulted in the tiered approach, as explained in Section 4.
- Making the assessments useful to town officials, the public, and suppliers.

The Technical committee reviewed and commented on every step of the delineation, inventory and assessment phases of the final SWAP. URI Cooperative Extension Service has been assessing the threats to drinking water sources as a "decision support tool"; DEM's Office of Water Resources has worked closely with towns and suppliers in developing Wellhead Protection Programs; Providence Water has had an aggressive source protection program in place for years. In pursuing these programs and others, they have faced many

of the issues that the state has had to answer in developing this Plan. The Source Water Assessment Program is really a joint effort of all of the people involved.

In the area of delineation, the Wellhead Protection Program has already addressed the main issues, and resolved them under the EPA-approved WHPP.

Section 4. Source Water Assessment Plan

The Source Water Assessment Plan has four major parts, as follows:

- Delineate of a Source Water Protection Area (SWPA).
- Inventory the Potential Sources of Contamination (PSOCs) in the SWPA.
- Assess the risk associated with each PSOC, and the overall susceptibility of the water supply to contamination.
- Make the results of the assessments available to the public.

Each of these steps will be explained below.

Delineation (See Table 5.)
Delineation of a Source Water Protection Area involves drawing a line on a map that, ideally, indicates the surface area contributing water to the reservoir or well. For surface water reservoirs, the delineation is based on topography and is the same as the watershed uphill (and upstream) from the intake. For wells, it represents the land surface of a three-dimensional shape from which the well draws water. Various methods are used to estimate ground-water recharge areas, as discussed below.

The state recognizes the difficulty of accurately determining the recharge areas of any water supply, and further recognizes the limited utility in doing so. In areas of fractured bedrock, such as much of Rhode Island, ground water may cross topographic watershed divides and serve to recharge surface water; surface water may do the same and recharge an aquifer in an adjacent watershed. We will therefore continue to use the best available information to delineate both ground and surface water recharge areas, but we will also continue to encourage municipalities to go beyond the designated Source Water Protection Areas in their protection efforts.

Inner Protective Radius: For public wells that are gravel-packed or gravel-developed wells, a 400' inner protective radius has been established under Department of Health regulations. For all other public wells, this protective radius is 200'. This is not a recharge area, but is intended to protect primarily against bacteria and nitrates associated with nearby septic systems and other sources of these contaminants. It also serves to keep the wellhead area free of other potential contaminants that could enter the wellhead through overland flow. History has shown it to be a conservative distance. The land use within this radius must remain under the direct control of the water supplier (though variances may be granted), and should be reserved for the protection of the water supply. Other uses may be allowed at the discretion of the Director of the Department of Health.

Department of Health inspectors conduct a detailed inventory of this area at least once every five years, in addition to assessing the integrity of the wellhead itself. The supplier is notified if unsanitary conditions are found, and is required to correct such situations and respond to the Office of Drinking Water Quality with a description of corrective actions taken. In addition, if contaminants are detected (during routine sampling) that may indicate a problem with wellhead integrity, the supplier is required to take appropriate action to determine the source of the problem and correct it.

The inventory information gathered during these routine inspections will be used in the Assessment procedure. Any land use within the Inner Protective Radius may be considered to be a point source of high risk, by virtue of its proximity to the wellhead. This is discussed further in the Inventory section.

The consensus of the Technical and Public Advisory Committees is that, since the issue of wellhead integrity is addressed through these other programs, and since no confined aquifers exist in Rhode Island, that wellhead integrity itself should not be considered in the Source Water Assessment. However, the aquifer type, depth, depth to bedrock, etc. will be considered in assessing the overall susceptibility of the source, according to the results of the USGS Vulnerability Study (Table 7).

Groundwater Recharge Areas: The basic approach to the delineation of groundwater recharge areas will be the same as that developed under the EPA–approved RI Wellhead Protection Program. The details of that approach are appended to this Plan as Appendix 7. Some of the issues confronted under that program are discussed below.

All groundwater systems had a delineation of their Source Water (or Wellhead) Protection Area (SWPA/WHPA) drawn under RI DEM's Wellhead Protection Program. In brief, high-yield wells (those pumping more than 10 gallons per minute) finished in stratified drift deposits were drawn using mathematical flow models in conjunction with hydrogeologic mapping, or using analytical flow models developed with the aid of test wells. For bedrock wells and smaller, low-yield (less than 10 gpm) non-community wells, such data is not generally available. For the smaller wells, a generalized equation describing ground-water flow was used to arrive at a circle with a radius of 1,750 feet. For large bedrock wells, a radius depending on the maximum pumping rate was drawn; topographic contours were then used to determine groundwater that flows into the circle.

When a well draws water through the ground from a nearby surface water body, and the well water is chemically and physically similar to the surface water, it is said to be "ground water under the direct influence of surface water". In this case, it may be advisable to delineate the entire watershed of the surface water body as part of the Wellhead Protection Area. However, in Rhode Island it has not been found that there are wells so closely connected to surface water that such "conjunctive delineation" is necessary. As refined delineations are drawn, this may change, and assessments for those systems will be amended as necessary and as resources allow.

In some parts of the country, water may come from areas that are not adjacent to the wellhead. This would require that a protection area be delineated that separated from the wellhead. This issue was addressed under the EPA-approved Wellhead Protection Program. To date, this situation has not been found to exist in Rhode Island. If future studies indicate otherwise, protection areas will be redrawn to include such remote areas, and the assessments will be amended.

The Technical Advisory Committee selected certain wells to have refined WHPAs delineated. The selections were made on the basis of explicit criteria. Refined

delineations will use more site specific data and more complex flow models than those originally used. The selection criteria are as follows:

- Only high-yield wells, supplying a large percentage of a System's water, were considered for refinement. These are located primarily in stratified drift deposits.
- Some of the high-yield wells are located in highly developed areas and are therefore at higher risk of contamination. It was felt that some of these should have greater certainty attached to their delineations to be sure that they are adequately protected.
- Complex hydrogeologic settings require more advanced models. The committee felt that the WHPP-approved delineation method was not well suited to these settings.
- New community wells that are currently using a default protection area radius of 1,750 feet (as required under Department of Health regulations) should have refined delineations drawn. In one case, a community water system has acquired a former non-community well; this change in status makes a new delineation advisable.
- Some municipalities are preparing Wellhead Protection Plans or zoning ordinances based on the delineations of their Protection Areas. Increased confidence in the delineations may forestall legal challenges to such actions.
- In some areas, work has been done under other programs or agencies that have resulted in better flow models than were originally used. This work will allow refined delineations to be adopted at little cost to the SWA Program.

The wells selected for delineation refinement are as follows:

- Richmond Water Department Wells 1 & 2
- Chariho School wells, Charlestown
- Abbott Run Wells, Cumberland
- Tifft Road Well (formerly Industrial Park well), North Smithfield
- Crandall Well, Westerly
- Genessee Brook Well, Kingston Water Department
- Manville Area (5 wells), Cumberland/Lincoln

USGS has submitted proposals to do this work. The state has not yet accepted these proposals, and the Advisory Committee may be asked to reconsider the selections based on budgetary constraints. The proposed timelines generally coincide with those proposed under this plan. In any case, the Technical Committee felt that most refinements would result in smaller protection areas, therefore not requiring further inventory effort but only re-clipping RIGIS data to the new shape.

Surface Water Recharge Areas: The Source Water Protection Area for a surface water supply is the entire watershed of that water body above the drinking water intake. DEM and USGS have delineated these, using topographic watershed boundaries (see map of Drinking Water Watersheds, Appendix 6). In the process of mapping protection areas, these watershed delineations will be checked against 1:24000 USGS topographic maps and corrected where necessary.

For purposes of assessing the threats to raw water quality, a standard setback of 200' from the water's edge (reservoir or contiguous stream) will be used as a buffer zone. The setback will be mapped using RIGIS hydro-polys and hydro-lines, which were developed using 1:24000 USGS maps. The limitations of this method will be considered when ground-truthing inventory data.

This setback is a conservative one, being over twice the current USDA standard for streamside buffers (USDA Forest Service Pub. #NA-PR-07-91). Where Group C and D soils (see Soils, Table 3) are present in the riparian zone, a wider buffer may be adopted. All development within this buffer zone will be classified as high risk, by virtue of its location. In highly developed watersheds, the inventory effort will focus on this buffer zone, and all development within that zone will be listed; only high-risk development will be identified in the rest of the watershed (see Inventory section).

Overlapping Source Water Protection Areas: Many recharge areas in Rhode Island overlap. These areas will be addressed in varying ways, depending on the type of delineation method used and the recommendations of the local advisory committees.

Where well clusters are in high-yield aquifers that have had extensive modeling done, all of the wells will be considered as one, since this is how the groundwater flow models were generated. One assessment will be done for the entire wellfield, with appropriate documentation of the hydrogeological studies done.

Where WHPAs exist in surface water reservoir watersheds, the WHPA will be considered independent of the surface water, since it has been determined that there are no wells in Rhode Island “under the direct influence of surface water”.

Where overlapping WHPAs have been delineated using the “calculated fixed radius” method (bedrock wells and small non-community wells), each will be considered separately. In addition, a composite table of non-point sources will be generated for the combined WHPAs. The local committee may evaluate the utility of each approach. If and when refined delineations are produced for these wells, maps and inventories will be updated as resources allow.

In towns where many small public water supply wells exist, the residents typically rely on private wells for domestic water supplies. For this reason, as well as the reasons discussed above, towns have been and will continue to be encouraged to adopt groundwater protection strategies that extend beyond established protection areas.

Inventory

At best, an inventory is a snapshot of land use at one point in time. Rhode Island will start with existing land-use databases and seek to update them through public participation. Sources of all contaminants regulated under the federal Safe Drinking Water Act, as well as certain other contaminants regulated by the state, will be included in the inventory, either as point sources, non-point sources, or both. In addition, potential sources of contaminants that are not yet regulated will be noted; in particular, for ground water, potential sources of *Cryptosporidium* and *Giardia* will be identified.

For each source of drinking water, the entire delineated SWPA will be mapped with the Anderson Level III land-use categories, and identified as per Table 2 with a risk ranking. The software developed by URI will generate summary data of percentages in each land use category, and percentages on each hydrologic soil group (Table 3). High-risk land use on highly permeable soils (for ground water systems) or highly impermeable soils (for surface water systems) will be highlighted on the summary maps to be generated in ArcView.

For groundwater systems, land use within the Inner Protective Radius is already scrutinized under the Department of Health inspection program. Any source of regulated contaminants within this radius will be listed as a high-risk point source, unless precautions are taken to safeguard the wellhead from contamination.

In highly developed surface water protection areas, point-source inventory effort will be focused on the 200' riparian buffer zone, and contiguous highly impermeable soils (the extended drainage network). In addition, the highest-risk commercial and industrial facilities, as listed in Table 1a, will be identified throughout the watershed.

Initially, the following sources of information will be used. The method for combining these features into an assessment is discussed in the next section.

Land Use: For the purposes of identifying threats to drinking water, and of addressing protection efforts to deal with those threats, the state will consider non-point and point sources separately. In this context, a point source is an individual commercial or industrial, or institutional facility, while a non-point source is a land use that involves a wider area and disperses its waste. For example, car washes, dry cleaners and landfills will be called point sources, while areas of residential, institutional or commercial/industrial development will be called a non-point source.

Non-point sources will be identified through the RIGIS land-use classification system (see below). Inventories of point sources will be gathered from various databases, including EPA Toxic Release Inventory, Waiver Program files, and the Wellhead Protection Program. Where the RIGIS database indicates institutional, commercial or industrial land use, this will be included among the non-point sources; a separate table will identify the individual institutional, commercial and industrial facilities.

The Rhode Island Geographical Information System (RIGIS) has digitized land-use polygons from 1995 aerial photography. The land-use categories are based on a modified Anderson Level III classification system. (Anderson, J. R., Hardy, E. E., Roach, J. T. and Witmer, R. E., 1976, "A Land Use and Land Cover Classification System for Use with Remote Sensor Data," U.S. Geological Survey, Professional Paper 964, p 28, Reston, VA.) A table of risk factors assigned to the land-use categories is appended as Table 2.

Point sources, specifically institutional, commercial and industrial land uses, will be identified by Standard Industrial Classification (SIC) code. Extensive listings are available from a variety of sources, including EPA's Toxics Release

Inventory (TRI) database. Past inventory efforts by suppliers and state agencies have resulted in accurate but dated lot-by-lot lists. In addition, local inventories will be conducted, as set forth in Section 5 of this plan.

Soils: The ability of pollutants to move through various soil types is a critical factor in determining the inherent vulnerability of a water supply. Highly permeable soils will allow water (and soluble contaminants) to move quickly toward a working well or nearby surface water, while impermeable or shallow soils will allow runoff to surface waters. Therefore an important part of the state's approach to Source Water Assessment is locating potential pollution sources that lie on highly permeable soils (in groundwater protection areas) or impermeable or shallow soils near surface waters. The NRCS soil grouping system includes a category that considers "soil hydrology". It assigns one of four classes to a soil, from "A", highly permeable, through "D", highly impermeable. Soil groups and their assigned risk to ground and surface waters are appended as Table 3.

Other Geographic Features: RIGIS has coverages that include political boundaries, water and sewer lines and service areas, NRCS soils classifications, census data, protected lands, CERCLIS sites and Underground Storage Tanks (UST's), water bodies and streams, groundwater classification, and a variety of other geographical information (see Table 4). Through the state Department of Transportation, we should soon have access to aerial photographs at a scale of 1:5,000 from 1997 flyovers. These will provide much finer resolution than the photos used for land-use classification, and will also be used to correct wellhead locations where necessary. USGS topographic maps are also available in digital image format, and can be overlain with the other coverages.

These data sets are continually being improved, and the most up-to-date data will always be sought through direct contact with the agencies responsible for each data set relevant to SWA. Similar systems exist in neighboring States, and their data will be sought as necessary to assess cross-border protection areas and water supplies.

Other Necessary Data: The assessments also depend on system data, collected under various programs within the Office of Drinking Water Quality.

All public water suppliers are required to test their water (raw and after treatment) on a regular basis and report the results to the state. Reports will be generated for each system showing a history of detection of contaminants in the raw water, which would indicate susceptibility.

Inspectors from the Office of Drinking Water Quality visit each system at least once every five years to verify compliance with state health standards. Wellhead and intake integrity are assessed, and detailed drawings (at a scale of 1:1000) showing all land use and topography within the inner protective radius are produced. Any shortcomings are noted, and the supplier is required to correct deficiencies and notify the office of actions taken. Frequently, the most immediate threat to water quality is the activity at the supplier's facility, such as waste disposal or fuel storage. Results of the most recent survey will be summarized in the final Assessment, and relevant inventory data will be included in the land use and/or point source tables.

For most wells, the Department of Health has well drillers' reports that indicate well depth, depth to bedrock, and other information that relates to the potential vulnerability of the source. The USGS Vulnerability study (see Appendix 5) has correlated these characteristics with contamination, providing an objective measure of relative vulnerability to the various classes of contaminants.

Updating Inventory Information: The Department of Health and URI CE will approach the inventory effort on a town-by-town or regional basis, as appropriate. Where community groups are already active, we will seek to have SWAP activities incorporated; where no such groups exist, we will seek out the following people and groups:

- all public water suppliers within the town or region
- town government: planners, conservation commissioners, etc.
- local land trusts, local citizens' groups, Chamber of Commerce, others
- business groups, especially developers and real estate agents
- RI DEM, Office of Water Resources
- URI Cooperative Extension Service
- Conservation District representatives
- Water Resources Board

Complete discussion of the committee structure and function can be found in the Section 5, Public Participation and Reporting.

Where the Department of Health feels that a source is at high risk to contamination, based on the results of the USGS Vulnerability Study, and local volunteer inventory effort is lacking, the Department will, as resources allow, seek more detailed and up-to-date information. The determination on which systems to address will be made according to the following criteria:

- History of significant detection of contaminants. For the purposes of SWAP, "significant" is taken to mean any detection of more than half of the Maximum Contaminant Level (MCL), or a history of detection of lower levels. A history of detection would obviously indicate that a water source is "susceptible".
- Highly threatened source; that is, a large percentage of its SWPA is developed.
- Sole source of water for a system.
- Sensitivity of population served, such as schools, hospitals, etc.

For this "second tier" inventory, the following types of information will be sought: first, recent changes in land use (since 1995). Then, to the extent possible (based on time and resources available), the age of PSOCs, the amount of potential contaminants involved, natural mitigation or exacerbation of the potential for contamination, and other site-specific information.

Inventory data, as gathered by local volunteers or Department of Health staff, will be entered into a digital database in a common format that can be easily updated. A template will be developed and distributed on floppy disk to all committees, with fields for name of business, address data and type of business or land use. This will assure consistency of format. The "associated risk" fields will be automatically filled in the ArcView GIS program when the land-use

data is mapped. Any risk factor applied can be modified on a case-by-case basis if Best Management Practices are being employed or if other mitigating circumstances exist.

Transient Non-Community (TNC) Systems: These systems are required to test only for nitrates and microbes, since these are the contaminants associated with acute rather than chronic health effects. The entire SWPA of these systems will be mapped to identify land uses associated with these contaminants. Only sources of these contaminants need be inventoried, though sources of other contaminants may be noted as well. Anderson Level 3 land-use coding can identify most sources of the relevant contaminants, since they are mostly non-point sources. Those in closest proximity to the wellhead (within the Inner Protective Radius) or to the riparian zone of surface-water systems, will be identified from Department of Health Sanitary Survey reports.

Sources of nitrates and microbes include stormwater discharges, sewer lines, septic systems, certain agricultural activities, and wildlife. Those agricultural activities that generate these contaminants are broken out in the land-use classification system we will be using (see Table 2). Comparing residential areas to those areas served by public sewer systems can identify areas served by septic systems. In addition, sewers installed before 1988 (the previously available set of land-use data) can be identified, since those are more likely to leak.

Community and Non-Transient, Non-Community (NTNC) Systems: Potential sources of all regulated and unregulated contaminants will be listed as PSOCs, and will be inventoried throughout the SWPA.

Trans-Boundary SWPA's: Where time permits, these will be addressed in the same manner as in-State areas. The New England Interstate Water Pollution Control Commission has received a grant from the US EPA to provide the necessary GIS data coverages of Connecticut and Massachusetts; other data already exists in Department of Health and DEM files. Where further inventory activities are indicated, they will be undertaken in the same ways as are in-state inventories.

Assessment

"Vulnerability" and "Susceptibility" are defined as follows (see the Definitions Section):

- **Vulnerability**: a hydrogeologic situation in which a water supply would be prone to contamination if a source of contamination were present. It depends primarily on soil type, topography and subsurface geology. Surface waters are generally more vulnerable in areas with impermeable soils or nearby high water tables with highly permeable soils, which allow rapid movement of contaminants toward the water body. Groundwater sources are more vulnerable in highly permeable soils.

- **Susceptibility:** the presence of a source of contamination (PSOC) in a vulnerable situation.

- A "**Susceptibility Assessment",** therefore, is an analysis combining land use and vulnerability information to estimate the likelihood that a water source will become contaminated. It will result from summing the numerical risk values assigned to each of the inventoried land uses, weighted according to the percent of the protection area each land use occupies. The land-use risks themselves will result from summing the risks associated with the type of land use, the soil type on which it occurs, and the proximity to the wellhead or surface reservoir (point sources) or the total area involved (non-point sources). For each protection area, a final risk factor will be added to represent the well or water body itself, incorporating such factors as well depth, aquifer type, trophic status (surface water), etc. These factors are discussed in detail below.

An initial susceptibility ranking among community and non-transient non-community ground water sources has been completed by the United States Geological Survey. It is based on land uses and geology within the WHPA, well characteristics, and monitoring history of the well. The same criteria will be applied to transient non-community systems, but limited to the factors found to be significant for contaminants for which the TNCs are required to test (nitrates and bacteria). This initial ranking will assist the state in focusing inventory and assessment efforts.

Assessments will be based on the following criteria:

Vulnerability of the source:

- The permeability of the soils within the protection area.
- The history of contamination of the raw (untreated) water.
- The characteristics of the water body itself, including (for wells) aquifer type (bedrock, alluvial, etc.), finished depth, depth to water, and depth to bedrock (from Department of Health inspections and drilling records). Where such records are not available (mostly older wells), the risk will be assumed to be high. The risk from these factors will be based on the findings of the USGS Vulnerability Study (See Appendix 5 and Table 7). For surface water, the flushing rate, trophic state and 305(b) (federal Clean Water Act) classification will be considered.

Susceptibility of the source to each PSOC:

- For non-point sources, including areas of commercial/industrial development, the Anderson Level III land-use category, and the percent of the SWPA in each category. Each category will be ranked, rather than ranking individual parcels, although in mapping the protection areas, parcels that represent high risk due to land use and underlying soil type will be highlighted.
- For point sources (institutional, commercial, industrial, and *any* PSOC within the Inner Protective Radius), the distance of each PSOC from the wellhead or intake. This is in addition to land-use classes indicating commercial or industrial areas, which will be included as a non-point class. In highly developed WHPAs, only those facilities that are considered to be in the high-risk category will be listed. In highly developed watersheds, all businesses within the buffer zone will be listed, along with high-risk facilities throughout the watershed.

Relative susceptibility among community and non-transient non-community ground-water sources has already been determined by the USGS Vulnerability Study. A ranking is also being prepared using the results of the MANAGE program (URI Cooperative Extension Service) for purposes of comparison.

Tables are appended to this plan showing the risk factors that will be applied under each criterion. For each land-use class, points will be assigned for land-use risk, underlying soil-type risk, and total area risk (see Tables 1 – 3). Land-use classes will be ranked according to the number of points received. Point sources will then be ranked separately, with "distance from wellhead" replacing the total area category. Commercial and industrial facilities (point sources) will receive risk points from Table 1a; these can be changed on a case-by-case basis where mitigating or exacerbating circumstances exist.

The protection area as a whole will be given a "susceptibility determination" by summing the risks of all land-use categories, along with occurrence of point source PSOC's, aquifer characteristics and history of contamination. Large areas of high-risk land uses coinciding with high risk soil types will result in a high susceptibility rating for a source. The method and tables are included as Appendix 11.

An assessment will consist of the following elements:

- A description of the water source, intake or wellhead, and protection area, and the method used in delineating the recharge area.
- Ranked inventory lists of PSOC's, along with a narrative explaining the nature of each PSOC as it relates to drinking water quality. Point and non-point sources will be listed separately, along with the regulated contaminants normally associated with each. Inventories of non-point sources will indicate the percentages of the SWPA's land occupied by each, and the underlying soil types. Inventories of point sources will include the name and address of each, the distance from the wellhead or intake, and the nature of the business or activity at the site as it relates to the use of relevant contaminants.
- A list of regulated and unregulated contaminants that have been detected in the water supply, and the land uses or businesses that are typically associated with each.
- Maps for each SWPA, indicating the delineated SWPA, land use, topography, locations of point source PSOC's, and soil types. High-risk land use coinciding with high-risk soil types will be highlighted.
- The overall susceptibility ranking of the water source, as compared to other water sources in the state.

Assessing Water Sources: The state will contract with URI CE to run the MANAGE Program on large suppliers' Source Water Protection Areas, for both ground and surface waters (see Appendix 10). The Department of Health will use a slightly modified and simplified version of the same computer modeling software to assess the sources of small community and all non-community suppliers. Point sources will be mapped and ranked separately from non-point sources, although in highly developed watersheds (e. g. Newport and Pawtucket) such a list is unlikely to be useful, since it would run to several hundred individual businesses. In these cases, the assessment will focus on all land

uses within the 200' buffer zone, and on high-risk facilities and land uses throughout the rest of the watershed (see Table 1a). In large surface water basins, such as the Scituate watershed and Aquidneck Island, the basin may be divided into sub-basins to facilitate assessments and guide protection efforts. Results will be distributed to suppliers and the local committee, along with the results of the MANAGE Program, for review and correction. Completed assessments will be posted on URI's Internet web sit as soon as they are deemed complete by the Department of Health, and will be published as possible thereafter.

Oversight: As each town's or region's final assessments are prepares for printing, the state will review the work of the USGS in refining delineations, the work of Home*A*Syst in training volunteers and gathering data, and the work of URI Cooperative Extension in preparing the assessments for the large suppliers. The state will be working closely with all three throughout the process, so adherence to agreed-upon timelines will be addressed jointly.

Updating Assessments: An important goal of the Source Water Assessment Plan is to make it useful into the future. To that end, we plan to keep all data in an electronic format that will be easily accessible and easy to update and correct. We also plan to keep all data fields, rather than the ones we decide are relevant now, so that the application may be modified as needed in the future.

Various programs exist that could be used to update inventory information, such as the Waiver program and the Water System Supply Management Plans. Monitoring waivers are granted for three-year blocks.

Under current law, an updated inventory is required as a condition for having a monitoring waiver renewed. If this inventory information continues to be provided, it could be entered into the assessment database as time and resources allow, and effectively serve to update assessments on a three-year cycle.

The large suppliers, who serve over 60% of the State's population, are currently required to update their Water System Supply Management Plans on a five-year basis. New information contained in these plans may also be used to update assessments. Results would be available for inclusion in the annual Consumer Confidence Reports.

Assessment Procedure

1. Delineation: Document delineation of the Source Water Protection Area for the source. Summarize the hydrology, geology and topography of the SWPA. This information is already contained in the Waiver files at the Department of Health for all small Community and Non-transient, Non-Community systems. USGS will coordinate with the Departments of Health and Environmental Management and URI CE to prioritize those wellheads selected for refined delineations.

2. Inventory: Create ArcView shape files with USGS quad, roads, land use, protection area overlays, and other available relevant digital data. Assemble

non-digitized inventory data; use Wellhead Protection Program, Sanitary Inspection Reports and Waiver files to assemble existing inventory information. Contact suppliers for their assistance in updating inventory. At the town level, contact the town planner, Conservation Commission, and watershed groups to convene a committee, or coordinate with an existing committee to address Source Water Assessment.

3. Locate point sources on ArcView as available. For surface water sources, create setback of 200'. Build a table of point sources and a table of non-point sources. Use ArcInfo to "union" (unite) soil category to point source category and calculate acreage in each soil category for non-point source land uses. Include a column for distance from intake or wellhead for point sources, and a total acreage column in the non-point table. (Note: these tables are created in the MANAGE Program software, as it will be used by the Department of Health.) Print maps and tables, and forward to supplier and local committee members and Home*A*Syst volunteer teams for comment and correction.

4. Assessment: Each PSOC will have a risk value assigned, and a total risk value for the SWPA will be generated. As regional and town-wide assessments are completed, it will be possible to compare SWPAs' total risk values and generate a priority list for Second Tier assessments.

5. Bring tables back to ArcView and plot threats with appropriate color-coding. Separate maps for point and non-point sources may be appropriate for clarity. Prepare maps for final publication.

6. List contaminants detected in the raw water and the activities associated with each.

7. Create a ranked list of all inventoried land use categories, and the regulated contaminants associated with each.
   - Point source risk will be determined by summing the risks from three categories: risk from the land use, risk from proximity to intake or wellhead, and risk from soil type.
   - For non-point sources, "distance from wellhead" will be replaced by "total area in SWPA".

8. Compile narrative: Using Waiver file text as a basis, discuss delineation method, inventory databases, soil types present, general land use and development trends, and relevant commercial and industrial activities in the protection area. Include the tables with ranked threats, and a summary table of land uses in the protection area, and discuss the threats posed by the highest-ranked threats. Review results with the local committee.

9. Release: As soon as the local committee members have had an opportunity to review the assessments for accuracy, the results will be posted on URI's Internet web site. The state will request proposals to prepare and publish assessments during the first year of assessments, with the stipulation that all assessments must be published within four months of the date of completion. This will allow all assessments to be completed and published well within the statutory time frame of 3.5 years, assuming that the state is

granted an 18-month extension, as requested.

Assessment Format:

I. Introduction
   Reference to SDWA, purpose and intended beneficiaries
   Monitoring flexibility
   Contacts for more information

II. Drinking Water
   Geology, hydrology, topography
   Overall land-use trends, water quality, history of detects

III. Assessment
   Relationship of land-uses and soil types present
   Non-point sources: ranked list and map
   Point sources: ranked list and map
   Discussion of primary threats ("hot spots")
   Overall “Susceptibility Ranking” of water source

IV. Management Options
   Education and Outreach: Best Management Practices
   Zoning for Water Quality Protection, Easements, and Fee-simple purchase

V. Maps and Tables
   Table of regulated contaminants, with associated land uses.
   Table of inventoried land uses, with associated contaminants.
   Summary table of risks:
      Percent of SWPA in each land use category.
      Land use map, with point sources; Soils map; Topography.
      "Hot spot" map of high-risk land uses in sensitive locations.

Time and Resources Required

The State has requested and been granted the full 10% of the 1997 set-aside for the Source Water Assessment Program. One full-time staff person has been hired, and a computer sufficient for GIS data processing has been purchased. The state has also purchased the necessary GIS software to conduct the assessments.

Delineations have been done for all ground and surface water sources in the state, as discussed in the Delineation section. Where refined delineations are being done by USGS, the state will coordinate with USGS to have timely access to that data. The remaining activities (Inventory, Assessment, and Public Release) for each town or region will be done in the time frames below.

All supplies (Community and Non-Community) will be assessed in each of the areas listed during the time period indicated. Where public interest is high and development has been intense, this schedule may have to be expanded to allow more time for updating inventories. As refined delineations become available, inventory areas will be adjusted and new maps will be printed and distributed.

Spring, 2000 - Fall, 2000 March 2000 – November, 2000
Town of Burrillville (Western Blackstone River Basin), Glocester, Foster, Scituate, Johnston, Cranston (Scituate Reservoir, Providence Water), Newport (Aquidneck Island, Watson and Nonquit Reservoirs)

Winter, 2000 - Spring, 2001 December, 2000 – May, 2001
North Kingstown and RI EDC, URI and Kingston, South Kingstown, United Water (Wakefield), Westerly; Charlestown, Hopkinton, Richmond, Exeter, West Greenwich (Wood-Pawcatuck River Basin). The proposal from USGS to refine delineations in this area includes a completion date of October 2000.

Summer, 2001 - Fall, 2001 June, 2001 – November, 2001
Jamestown, Kent Co., Bristol Co., Tiverton/Little Compton (except Watson and Nonquit Reservoirs), Coventry

Fall, 2001 - Spring, 2002 December, 2001 - June, 2002
North Smithfield, Cumberland, Pawtucket, Lincoln, Woonsocket (Eastern Blackstone River Basin)

The state is allowing a longer time for the first set of assessments to be completed, in order to develop and trouble-shoot the approach. These also represent very highly developed watersheds and/or large land areas. The sequence of events in each area will follow a similar pattern, as detailed below in Section 5.

Section 5. Public Participation and Reporting

Public meetings will be scheduled at the local or regional level, and occur during the State's Assessment process. Their purpose will be threefold: first is the need to inform the public of the SWA Program and its bearing on water quality and land use. The second is to encourage local volunteer effort to update land-use information. The third is to solicit feedback on how the suppliers, the Department of Health, or others can more effectively reach out to the public with the results of the assessments, and how the assessments can lead to protection. As citizens, suppliers and town officials participate in the assessment process, its utility will be recognized and strengthened.

Public participation is an integral part of the MANAGE Program. Since there is substantial overlap among large suppliers' SWPAs and the smaller suppliers' SWPAs, the same committees convened for the large suppliers' assessments will assist with the assessment process for the entire municipality or region involved. This will minimize the time commitment for members of the committees.

The state's large suppliers have expressed an interest in chairing committees in the areas where they either draw water or supply water, and the Department of Health and URI CE feel that this is, in most cases, appropriate. The committees will assess the types of water supply systems within the town (or region) and available inventory data, and determine the important issues and overall approach for assessing water supplies within the town, within the framework of the approved SWA Plan.

The Department of Health and URI will provide the committee members with maps showing RIGIS land-use data within the SWPAs in town, and lists of known point sources (institutional, commercial and industrial facilities, dumps and landfills, etc.). The committee will evaluate them for accuracy, and update or correct them where necessary. If the committee feels that field verification is necessary, they will be charged with recruiting volunteers. Rhode Island Home*A*Syst will coordinate local volunteer efforts, as detailed in their proposal attached as Appendix 9.

Pilot projects have already begun. Meetings held in one town in the state (under a separate program) have determined the types of maps and formats that will be most useful in updating inventory information. A second pilot project will begin in March 2000 to develop the training program for Home*A*Syst volunteers and fine-tune the inventory procedure. Concurrently, the GIS program scripts that will automate the generating of maps and risk tables will be developed. Once these necessary precursors are completed, a more concrete timetable can be generated. These activities are being coordinated with the URI Cooperative Extension Service.

Initial meetings in the first group of towns or regions to be assessed (Providence Water (Scituate Reservoir), Newport Water (Aquidneck Island), and Burrillville) will begin in March of 2000. We will begin contacting existing groups in these areas in November of 1999 to be certain that the relevant people are involved and that their schedules will accommodate the needs of SWA.

The first two meetings of the local committees will introduce the concept of Source Water Assessment and present the land-use and inventory maps showing existing data. A time frame has been developed to allow four months for the local volunteers to receive training and gather up-to-date information. As the existing inventory data is reviewed and new data is collected and organized, the final SWA for each system will be assembled.

The agenda for the first meeting will include an introduction to Source Water Assessment, what we (the Department of Health and URI CE) will be doing, and what we are asking of the committees. We will request that the group choose a lead person who will be the point of contact for the Department of Health and URI CE. Small-scale (large format) maps will be presented. Existing data will be discussed, along with the need for updating that data. The committee will be given the options for participation.

Two options for updating land use data will be offered, along with two possible meeting schedules. The first option will consist of marking up large-scale paper maps of each SWPA with corrections of areas known to have been developed since 1995 (the date of our data). These maps, along with tables of existing land use data, would be distributed at the second meeting (about a month after the first), and completed maps would be delivered back to the Department of Health and URI. The assessments for all systems within the town will be run based on those updated land-use maps, and a third and final meeting will be held to distribute and review the results. Thereafter, the Department of Health and URI will prepare the final Assessments and post them on the Internet, and publish the final assessments. The total time required for this option would be on the order of six to eight months, depending on the level of enthusiasm and

the number of land-use changes that would need to be made in the database.

The second option will involve recruiting volunteers to do windshield surveys of areas in question. The decision to do this would be made at the second meeting, about a month after the first. Sources of volunteer labor, such as high school science classes, church groups (many of which require community service), etc., will be discussed. At this point, RI Home*A*Syst will step into arrange training for the volunteers and coordinate their activities.

Proposed Home*A*Syst Schedule:

- Month 1 - meeting with local committee to explain project and solicit volunteer group
- Month 2 - train volunteer group
- Month 3 - collect inventory data
- Month 4 - follow up and collect info that wasn't completed from month 3.

The committee may choose to direct inventory effort to certain areas, or to specific types of systems (e. g. large suppliers, or all community and non-transient non-community suppliers). In any case, a time limit must be agreed early in the process. If a town or region chooses to do complete inventories of all types and sizes of systems, it could add as much as four months to the entire process. For this reason, while the state estimates that assessments for a particular town or region could be completed and published within a six-month time frame, it could be necessary to extend that time to as much as ten months.

The state will report to EPA annually as assessments proceed. A form for such reporting, proposed by EPA, is appended to this plan (Appendix 8). This reporting will be combined with reporting for the Wellhead Protection Program.

Distribution: As each town or region's local committee reviews and approves the assessments for its public water supplies, the state and URI will prepare the results for publication. By the end of the periods allotted in the "Time and Resources" section, the results will be posted on the Internet at URI CE's web site. Final publication will be done under contract, and is expected to take another three to five months. If, as expected, the state is granted the 18-month extension, all assessments will have been released to the public by April of 2003. All materials collected as part of the SWAP effort will be available on request to the public. The local committees will have the opportunity to assist in developing an outreach strategy appropriate for their particular town or region, and existing groups will be enlisted to provide input. At least, copies of the completed assessments will be distributed as follows:

- suppliers,
- distributors (those systems that purchase all of their water),
- town planners and zoning boards,
- Soil Conservation Districts,
- other groups or individuals who participated in the local committees,
- public libraries

Providing copies of the complete assessments at other locations or to other entities will depend on the size and complexity of the assessments, and on local interest. For the large Community systems, a summary may be prepared that will include land-use maps and a ranked list of the types of PSOC's present in the SWPA, with a narrative explaining the significance of each type of threat. This will be offered as an alternative to a full report.

Community suppliers are required to provide their customers and consumers with a Consumer Confidence Report (CCR), annually beginning in 1999. When each system's assessment is completed, a summary will be provided to the supplier for inclusion in the subsequent CCR for that system, along with information on how a complete copy of the assessment can be obtained. All information gathered under the Source Water Assessment Program would be available to the public upon request.

Section 6. Protection and Monitoring Flexibility

Under several existing programs (see Section 2), protection efforts have been ongoing and successful. These will be given better access to relevant information by the SWAP process, leading to more efficient use of available funding.

The Water Resources Board collects a surcharge from the major water suppliers. This money is distributed back to suppliers for water quality improvement and protection efforts, such as land acquisition. The Source Water Assessments will be provided to the WRB and large suppliers to help better inform their land acquisition priorities.

In addition, large water suppliers are required to submit Water System Supply Management Plans, which detail their priorities in protecting their sources of water. These have in the past included prioritizing land parcels for acquisition, working with town officials in writing zoning ordinances, and working with the agricultural community in instituting best management practices. The Department of Health has worked with the Water Resources Board to incorporate Source Water Assessments into WSSMPs and to create a mechanism for the assessments to be updated.

The Department of Health will provide the Department of Environmental Management with copies of the assessments. We will work with DEM to see the results incorporated into the Wellhead Protection Plans and 305(b) reports. In addition, as the assessments proceed and high-risk land uses and facilities are identified, the Department of Health will provide the facility owners or managers, residents, or town officials with links to DEM programs that may help them to identify Best Management Practices to mitigate the potential risks. DEM will also be provided with relevant information on identified risks, relating in particular to the UIC Class V program.

One of the explicit benefits of Source Water Assessments is monitoring flexibility. Those systems that already have monitoring waivers granted by the Department of Health for certain regulated contaminants would have their

waivers extended for the 1999 - 2001 monitoring period. Upon completion of each assessment, waivers will be reviewed, and either extended through the 2002 - 2004 period or, if need be, terminated.

The University of Rhode Island Cooperative Extension runs the Home*A*Syst outreach program, which educates homeowners in protecting private wells from contamination. Part of Home*A*Syst's program is training volunteers to work in the community to educate residents. In cooperation with the Department of Health, this program will be expanded to reach residents of SWPAs, and to familiarize citizens and consumers with the results of the Source Water Assessments, and with how they can help to protect the public's water supplies.

All towns in Rhode Island are required to have Comprehensive Community Plans, and drinking water source protection is already a part of these plans. The information gathered through the Source Water Assessment Program can be used to update and fine-tune these plans to maximize the effectiveness of protection efforts. Town involvement throughout the process will help to assure this linkage.

The Natural Resources Conservation Service of the USDA has several ongoing programs aimed at instituting best management practices among the agricultural and residential communities; they will make use of the Source Water Assessments in setting priorities.

TABLE 1. Potential Sources of Contamination

Source: RI Wellhead Protection Program and Office of Drinking Water Quality. This table is included for reference purposes, since it is included in Department of Health regulations for new source approval, and in the Department of Environmental Management's Wellhead Protection Program. However, pending adoption of revisions into the regulations, the Source Water Assessment Program will use a modified version of the table (Table 1a).

Higher Risk

Airports-Commercial (maintenance & repair, fuel storage)
Automotive Body Shop
Boat Builders & Refinishers
Bus & Truck Terminals
Chemical Manufacturers
Dry Cleaners
Fuel Oil Distributors (product storage, equipment maintenance & storage)
Industrial Manufacturers
Junkyards and Salvage Yards
Machine Shops
Metal & Drum Cleaning/Reconditioning
Paint Shops
Photographic Processors
Printers and Blueprint Shops
Railroad Yards
Repair Shops (engines, appliances, etc.)
Rust Proofers
Service Stations (gas stations)
Furniture Strippers, Refinishers
Waste Storage, Treatment & Recycling (hazardous and non-hazardous)

Moderate Risk

Agricultural Related Activities (pesticide & fertilizer storage & application, machinery maintenance & fueling)
Asphalt, Coal, Tar & Concrete companies
Dredge Disposal Sites
Medical Facilities (hospitals, clinics, laboratories)
Military Facilities (past & present)
Nursing Homes
Pipelines (oil & sewer)
Prisons
Research Laboratories
Road Salt Storage
Schools, Colleges & Trade Centers
Wastewater Treatment Plants (past or present sludge disposal)
Wood Preservers

Lower Risk

Animal Care & Holding Areas (stables, kennels, pet shops)
Auto Parts Stores
Beauty Salons
Construction Sites
Food Processors (meat packers, dairies, bakeries)
Stormwater Management Facilities (leaching systems)
Funeral Homes & Cemeteries
Golf Courses
Hotels & Motels
Land Application of Sewage Sludge
Laundromats
Nurseries
Residential Development (low density) (lawn care, septic systems)
Restaurants & Taverns
Retail Shopping Centers, Malls
Sand & Gravel Mining Operations
Sawmills
Transmission Line Rights of Way

Transportation Corridors (road deicing, materials transport)	Utility Substations/Transformers Waste Transfer Stations

Notes to Table 1:

1. Not all agricultural applications of pesticides and fertilizers represent a moderate risk to groundwater. A number of factors are involved in determining the risk, and many applications can represent a lower risk. Refer to the Rhode Island Pesticide, Fertilizer, & Water Resource Assessment (DEM Division of Agriculture, 1998).

2. This list is not a substitute for investigating a specific source in order to determine its threat to groundwater, which may be higher or lower than indicated on the list.

3. The level of risk to groundwater associated with each category is based on the assumption that the sources are not using and/or releasing any potential contaminants that are not normally associated with the activity. In addition, the threat posed by facilities within a category varies depending on the safeguards or Best Management Practices employed to prevent contamination.

4. It is assumed that none of the categories in this table are being served by sewer systems. If sewer lines were to be brought to an area, the risk posed by certain categories could be reduced or increased.

5. Low risk is not to be confused with <u>no</u> risk. Sources in this category can and have caused groundwater contamination.

6. This list is subject to change, as more information becomes available about the threat posed to groundwater by these and other categories.

Table 1a. Point Source Risk Factors to be applied under RI's Source Water Assessment program. Based on MA DEP's Source Water Assessment Plan, Feb 1999. A higher number indicates a higher associated risk (1 = Low Risk; 3 = High Risk).

Land Use	Ground Water Risk	Surface Water Risk	Notes
Agriculture			
Dairy Farms	2	3	Manure Storage and Spreading
Fertilizer Storage/Use	2	2	
Forestry	1	2	pesticides, herbicides, runoff
Livestock (CAFO's)	3	3	None are known to exist in RI's SWPA's.
Nurseries	1	2	
Commercial/Industrial Activity			
Airports-Commercial	3	3	maintenance & repair, fuel storage
Asphalt, Coal, Tar & Concrete companies	1	3	
Auto Parts Stores	1	1	
Automotive Body Shop	3	3	paints and solvents
Beauty Salons	2	1	
Boat Builders & Refinishers	3	3	
Bus & Truck Terminals	3	2	fueling and service of vehicles
Chemical Manufacturers	3	3	
Dry Cleaners	3	2	halogenated solvents
Food Processors	1	1	meat packers, dairies, bakeries
Fuel Oil Distributors	3	3	fuel storage, equipment maintenance

Funeral Homes	1	1	
Furniture Strippers, Refinishers	3	2	solvents
Golf Courses	3	3	fertilizers and pesticides
Hotels & Motels	2	2	septage, fertilizers & pesticides
Industrial Manufacturers	3	3	Industrial solvents
Junkyards and Salvage Yards	3	3	VOCs, SOCs
Laundromats	1	1	cleaning solvents, detergents
Machine Shops	3	2	solvents
Medical Facilities	2	1	hospitals, clinics, laboratories
Metal & Drum Cleaning/Reconditioning	3	3	solvents
Nursing Homes	1	1	septage, fertilizers & pesticides
Paint Shops	3	2	solvents
Photographic Processors	3	2	processing waste
Printers and Blueprint Shops	2	2	solvents
Repair Shops	3	2	VOCs, SOCs
Research Laboratories	2	2	
Restaurants & Taverns	2	2	septage, pesticides
Retail Shopping Centers, Malls	2	3	VOCs, surface runoff
Rust Proofers	3	3	solvents, VOCs
Sand & Gravel Mining Operations	2	2	VOCs
Service Stations (gas stations)	3	2	USTs, VOCs, SOCs
Wood Preservers	2	2	Arsenic, Copper
Miscellaneous			
Dredge Disposal Sites	2	3	SOCs
Land Application of Sewage Sludge	2	2	Microbes

Military Facilities	3	3	VOCs, SOCs
Pipelines (Oil, sewer)	2	2	VOCs, microbes, nitrates
Prisons	2	2	fertilizers & pesticides
Railroad Yards	3	3	VOCs, SOCs
Residential Development (high density)	3	3	VOCs, SOCs, microbes, nitrates
Residential Development (low density)	1	1	VOCs, SOCs, microbes, nitrates
Residential Development (moderate density)	2	2	VOCs, SOCs, microbes, nitrates
Road Salt Storage	3	3	sodium, calcium
Schools, Colleges & Trade Centers	2	2	fertilizers & pesticides
Stormwater Management Facilities	1	2	VOCs, Runoff
Transmission Line Rights of Way	1	3	Pesticides, herbicides
Transportation Corridors	2	3	road deicing, materials transport
Utility Substations/Transformers	1	2	SOCs
Waste Storage, Treatment & Recycling (hazardous)	3	3	VOCs, SOCs
Waste Storage, Treatment & Recycling (non-hazardous)	2	2	
Waste Transfer Stations	2	2	
Wastewater Treatment Plants	2	3	Microbes, VOCs, nitrates

Table 2: Land Use Codes and Assigned Risk Values

CODE	DESIGNATION	EXPLANATION	RISK	MANAGE
111	RESIDENTIAL	High Density: >8 Dwelling Units per Acre	2	HIGH
112	RESIDENTIAL	Medium High Density: 4 to 7.9 Dwelling Units per Acre	2	HIGH
113	RESIDENTIAL	Medium Density: 1 to 3.9 Dwelling Units per Acre	1	MEDIUM
114	RESIDENTIAL	Medium Low Density: .5 to .9 Dwelling Units per Acre	1	MEDIUM
115	RESIDENTIAL	Low Density: <.5 Dwelling Units per Acre	0	LOW
120	COMMERCIAL / SERVICES	Primarily Sales of Products and Services	3	VERY HIGH
130	INDUSTRIAL	Manufacturing, Design, Assembly, etc.; Industrial Parks	3	VERY HIGH
141	TRANSPORTATION	Roads, Divided Highways >200 ft. Rows	3	VERY HIGH
142	TRANSPORTATION	Airport Runways, Terminals, Parking, Storage	3	VERY HIGH
143	TRANSPORTATION	Railroad Terminals, Parking & Repair Areas	3	VERY HIGH
144	TRANSPORTATION	Water, Sewer Facilities & Buildings	2	HIGH
145	TRANSPORTATION	Waste Disposal Areas, Landfills, Junkyards	3	VERY HIGH
146	TRANSPORTATION	Power Lines >100 ft. Rows	0	LOW
147	TRANSPORTATION	Waterbased Transportation Facilities, Commercial Docks	3	VERY HIGH
150	MIXED URBAN	Light Industrial / Commercial Uses	3	VERY HIGH
161	OTHER URBAN	Developed Recreation, Parks, Zoo, Golf Courses	2	HIGH
162	URBAN OPEN SPACE	Vacant Land	1	MEDIUM

163	CEMETERIES	Cemeteries	0	LOW
170	INSTITUTIONAL	Educational, Health, Correctional, Religious	2	HIGH
210	AGRICULTURAL LAND	Pasture, Hay Fields - Land not suitable for tillage	0	LOW
220	AGRICULTURAL LAND	Cropland, Intense Farming, Tillable Land	2	HIGH
230	AGRICULTURAL LAND	Orchards, Groves, Nurseries	2	HIGH
240	AGRICULTURAL LAND	Confined Animal Feeding Operations (CAFO's)	2	HIGH
250	AGRICULTURAL LAND	Idle Agriculture, Abandoned Fields	0	LOW
310	FOREST LAND	Deciduous Forest > 80%	0	LOW
320	FOREST LAND	Evergreen Forest > 80%	0	LOW
330	FOREST LAND	Mixed Deciduous 50 - 80%	0	LOW
340	FOREST LAND	Mixed Evergreen 50 - 80%	0	LOW
400	BRUSHLAND	Shrub, Brush; Areas Undergoing Reforestation	0	LOW
500	WATER	Reservoirs, Lakes, Ponds	0	N/R
600	WETLAND	Forested and Non-Forested Wetlands	0	N/R
710	BARREN LAND	Beaches	0	N/R
720	BARREN LAND	Sandy Areas Other Than Beaches	0	N/R
730	BARREN LAND	Rock Outcrops	0	N/R
740	BARREN LAND	Strip Mines, Quarries, Gravel Pits	2	HIGH
750	BARREN LAND	Transitional Areas	1	MEDIUM
760	BARREN LAND	Mixed Barren	0	LOW

Table 3: Soil Groups and Risk Factors

Name	Symbol	Hydrologic Soil Group	Risk to Ground Water	Risk to Surface Water
Adrian	Aa	A/D**	4	4
Agawam	AfA, AfB	B[3]	3	2
Birchwood	Bc	C	2	3
Bridgehampton	BhA, BhB	B[3]	3	2
Bridgehampton	BmA, BmB	B	3	2
Bridgehampton/Charlton	BnB*, BnC*, BoC*	B	3	2
Broadbrook	BrA, BrB, BsB	C	2	3
Canton/Charlton	CaC*, CaD*, CB*, CC*, CdA*, CdB*, CdC*, CeC*, ChB*, ChC*, ChD*, CkC*	B	3	2
Carlisle	Co	A/D**	4	1
Deerfield	Dc	B[3]	3	2
Enfield	EfA, EfB	B[3]	3	2
Gloucester	GBC*, GBD*, GhC*, GhD*	A/B[3]	3 or 4	1 or 2
Hinckley	HkA, HkC, HkD, HnC*	A[3]	4	1
Ipswich	Ip	D	1	4
Lippitt	LgC	C[3]	2	3
Mansfield	Ma, Mc	D	1	4
Matunuck	Mk	D	1	4
Merrimac	MmA, MmB, MU	A[3]	4	1
Narragansett	NaA, NaB, NbB, NbC, NcC	B	3	2
Newport	NeA, NeB, NeC, NfB, NoC	C	2	3
Newport (Urban Land)	NP	C	2	3
Ninigret	Nt	B[3]	3	2
Paxton	PaA, PaB, PbB, PbC, PcC	C	2	3

Paxton (urban Land)	PD	C	2	3
Pittstown	PmA, PmB, PnB	C	2	3
Podunk	Pp	B	3	2
Poquonock	PsA, PsB	C	2	3
Quonset	QoA, QoC	A[3]	4	1
Rainbow	RaA, RaB, RbB	C	2	3
Raypol	Rc	C[3]	2	3
Ridgebury	Re, Rf*	C	2	3
Rumney	Ru	C	2	3
Scarboro	Sb	D[3]	1	4
Scio	ScA, SdB	B	3	2
Stissing	Se, Sf	C	2	3
Sudbury	Ss	B	3	2
Sutton	StA, StB, SuB, SvB	B	3	2
Tisbury	Tb	B[3]	3	2
Walpole	Wa	C	2	3
Wapping	WbA, WbB, WcB, WdB	B	3	2
Windsor	WgA, WgB	A[3]	4	1
Woodbridge	WhA, WhB, WoB, WrB	C	2	3

Notes: ** Designated as D for SWAP

[3] Excessive permeability in the subsoil may cause groundwater contamination

Table 4. Relevant RIGIS Datasets

Data Set	Source	Description/Notes
CERCLIS	DEM	Point locations of hazardous materials sites as designated by US EPA and DEM
Community Wellhead Protection Areas	DEM/ HEALTH	Areas around public community wells considered critical for the protection of their source water supplies
Community Wells	DEM/ HEALTH	Wells serving at least 25 residents or 15 service connections year-round
FEMA Flood Zones	FEMA	100 year and 500 year flood zones
Groundwater Recharge Areas	DEM	Critical portions of recharge areas for major groundwater aquifers suitable as source for untreated drinking water
Industrial Areas	DOA	Land designated for industrial purposes by municipalities
Lakes and Ponds	USGS	All freshwater rivers and lakes as polygons
Land Use 1995	DEM	Land Use/Land Cover from 1995 aerial Photography, coded by Anderson modified Level 3 to 1/2-acre resolution. Includes change from 1988 coverage.
Non-Community Wellhead Protection Areas	DEM/ HEALTH	Areas around public non-community wells considered critical for the protection of their source water supplies
Non-Community Wells	DEM/ HEALTH	Non-community wells serving at least 25 persons at least 60 days per year
Public Water Supply Basins	DEM/ HEALTH	Surface water drainage basins and sub-basins for public surface drinking water reservoirs
Public Water Supply Reservoirs	DEM/ HEALTH	Surface drinking water reservoirs
RIMAPS 1	US Census	US Census 1990 Source Data & Calculated Percentages
Rivers and Streams	USGS	Centerlines of all fresh water rivers and streams, including some seasonal streams
Roads – all	DOT	All roads in RI including paved, unpaved and track/trail, with name attributes and annotation
Sewered Areas	DEM	Areas served by public sewers, as polygons
Soils	NRCS	Statewide soils coverage with attribute coding for soil type and potential for development

Sole Source Aquifers	US EPA	Areas in RI and nearby CT designated as sole source aquifers by US EPA.
Town Lines	DOA	City and Town Boundaries
USGS DRGS	USGS	USGS 7.5 minute quadrangles

Table 5. Delineated Areas around Public Water Sources

Type of System	Substrate	Inner Protective Radius (HEALTH)	Pumping Rate	Source Water Protection Area (DEM and HEALTH)
TNC	Gravel packed, gravel developed	400 Feet	<10 GPM	Calculated fixed radius
	Alluvial deposits	200 Feet		
	Bedrock			
NTNC	Gravel packed, gravel developed	400 Feet	<10 GPM	Calculated fixed radius
	Alluvial deposits	200 Feet		
	bedrock			
NTNC	Alluvial deposits	200 Feet	>10 GPM	Mathematical modeling and topography
	bedrock			
Small Community	Gravel packed, gravel developed	400 Feet	<10 GPM	Mathematical modeling and topography
	Alluvial deposits	200 Feet		
	bedrock			
Small Community	Alluvial deposits	200 Feet	>10 GPM	Mathematical modeling and topography
	bedrock			
Large Community	Alluvial deposits	200 Feet	>10 GPM	Analytical Modeling
Surface Water	N/A	200' Setback	N/A	Entire Watershed

Table 6. Contaminants of Concern

This is a list of all the contaminants that the US EPA currently regulates under the Safe Drinking Water Act. Testing for some regulated contaminants has been waived for the state. No Maximum Contaminant Levels have been set for the unregulated contaminants.

SOC Monitoring

Alachlor
Aldicarb
Aldicarb sulfone
Aldicarb sulfoxide
Aldrin
Atrazine
Benzo (a) pyrene
Butachlor
Carbaryl
Carbofuran
Chlordane
2,4-D
Dalapon
Di-2 (ethylhexyl) adipate
Di-2 (ethylhexyl) phthalate
Dibromochloropropane
Dicamba
Dieldrin
Dinoseb
Diquat
EDB
Endothall
Endrin
Glyphosate
Heptachlor
Heptachlor epoxide
Hexachlorocyclopentadiene
Hexachlorobenzene
3-Hydrocarbofuran
Lindane
Methomyl
Methoxychlor
Metolachlor
Metribuzin
Oxamyl
Pentachlorophenol
Picloram
Polychlorinated Biphenyls (PCBs)
Propachlor
Simazine
2,3,7,8-TCDD (Dioxin)
Toxaphene
2,4,5-TP (Silvex)

IOC Monitoring

Antimony
Arsenic
Barium
Beryllium
Cadmium
Chromium
Cyanide
Fluoride
Mercury
Nickel
Nitrate
Nitrite
Selenium
Sodium
Sulfate
Thallium

Regulated VOC

Benzene
Carbon Tetrachloride
Chlorobenzene
1,2-Dichlorobenzene
1,4-Dichlorobenzene
1,2-Dichloroethane
Trans-1, 2-Dichloroethene
1,1-Dichloroethene
Cis-1, 2-Dichloroethene
1,2-Dichloropropane
Ethylbenzene
Methylene Chloride
Styrene
Tetrachloroethene
Toluene
1,2,4-Trichlorobenzene
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethene
Vinyl Chloride
Xylenes

Unregulated VOC

Bromobenzene
Bromodichloromethane
Bromoform
Bromomethane

Unregulated VOC (cont.)

Chloroethane
Chloroform
Chloromethane
2-Chlorotoluene
4-Chlorotoluene
Dibromochloromethane
1,3-Dichlorobenzene
1,1-Dichloroethane
1,3-Dichloropropane
2,2-Dichloropropane
1,1-Dichloropropene
1,3-Dichloropropene
MTBE
1,1,1,2-Tetrachloroethane
1,1,2,2-Tetrachloroethane
1,2,3-Trichloropropane

Radiological

Gross alpha
Gross beta
Radium 226 & Radium 228

Microorganisms

Total Coliforms
Fecal Coliforms or E. coli
Cryptosporidium (not yet regulated)
Giardia spp. (not yet regulated)

Table 7. Relative Vulnerability Based on Well and Aquifer Characteristics

These vulnerability ratings are based on the results of the Vulnerability Study performed by USGS for the RI Department of Health, Office of Drinking Water Quality. Empty cells indicate that no correlation was found. A (+) indicates a positive correlation, while a (-) indicates a negative correlation.

Vulnerability	**nutrients**	**solvents**	**fuel HC's**	**pesticides**	**road de-icing**	**fluoride**	**radioactivity**	**microbes**
Stratified Drift	(+)	(+)	(+)	(+)	(+)			
depth		(+)		(+)		(+)		
depth to water								
Bedrock						(+)	(+)	
depth			(+)			(+)	(+)	
depth to water								
depth to bedrock								(-)

Appendix 1. Acronyms and Definitions

ASRWWA - Atlantic States Rural Water and Wastewater Association
Assessment - A description of the risks to a source of drinking water, ranking those risks according to the threat posed by each; also, s description of the overall susceptibility of a water supply to contamination.
Buffer Zone – The land area within 200 feet of surface water. This distance can be increased where soil types are particularly permeable.
Community Water Supplier - A PWS that supplies at least 15 service connections used by year-round residents or serves at least 25 year-round residents
Delineation - A line drawn on a map that describes the critical recharge area of a water supply.
DEM - Department of Environmental Management
GIS - Geographical Information System - a computer database that stores geographically referenced information.
Glacial till – Unstratified, unsorted sand, clay, boulders and gravel deposited directly by glacier ice.
Ground Water - Water existing in a saturated layer beneath the Earth's surface.
Inner Protective Radius - - A circle of radius 400' for gravel-packed or gravel developed wells, 200' for other types of wells, in which only drinking-water-related activities are allowed (except by special permission). Also called Zone A, or the Sanitary Protection Zone.
Intake - The point at which raw water taken in to be sent to a drinking water treatment facility.
Inventory - A list of all the Potential Sources of Contamination within a delineated recharge area (SWPA).
Maximum Contaminant Level (MCL) - The maximum allowable level of a contaminant allowed in drinking water by the US EPA.
MANAGE – (Method for Assessment, Nutrient-loading And Geographic Evaluation) A program developed by URI Cooperative Extension to estimate nutrient loading to ground and surface waters.
Non-point sources - A source of contamination that covers a wide area, such as septic systems in a residential area or fertilizer and pesticide application in an agricultural area. See "point source".
Non-transient, Non-Community Water Supplier (NTNC) - A PWS that serves at least 25 of the same non-residents for at least six months of the year, such as schools or factories.
Point Source - A source of contamination that is a single, identifiable point, such as a landfill, industrial site or storm drain.
Potential Source of Contamination (PSOC) - Any land use that uses, makes, stores, or disposes of potential contaminants. The presence of the potential contaminant within the SWPA in readily identifiable quantities is sufficient to label that source as "significant".
Public Water Supplier (PWS) - A water supply system that has at least 15 service connections or serves at least 25 people per day for at least 60 days out of a year.
RIGIS - Rhode Island Geographical Information System. A computer database of geographical information.
Safe Drinking Water Act (SDWA) - The Federal law that regulates Public Drinking Water Systems.

Sensitivity - The relative ease with which a contaminant can move toward a water source. The same as "Vulnerability".
Significant Potential Source of Contamination - see PSOC.
Source Water Assessment Plan (SWAP) - A plan that explains how the State will assess the threats to its sources of public drinking water, to the satisfaction on the US EPA.
Source Water Protection Area (SWPA) - The surface area from which a drinking water source is recharged. For surface water supplies, it is the same as the watershed, or high ground surrounding the water body. For ground water, it is the surface of the three-dimensional volume from which water is drawn to the well.
Surface Water - Water that exists on the surface of the Earth (lakes and ponds, rivers and streams, wetlands).
Susceptibility – the presence or absence of a source of contamination in a vulnerable situation.
Synthetic Organic Compound (SOC) - Synthetic substances containing carbon, such as pesticides and plastics.
Total Maximum Daily Load (TMDL) - the maximum amount of contaminant that a water body can receive daily without violating federal clean water standards.
Transient, Non-Community Water Supplier (TNC) - a non-community water system that regularly serves least 25 persons at least 60 days of the year.
US EPA - The United States Environmental Protection Agency.
USGS - United States Geological Survey.
Volatile Organic Compound (VOC) - Carbon-containing compounds that evaporate easily, such as those found in fuel oil.
Vulnerability - A hydrogeologic situation in which a water body would be prone to contamination if a source of contamination were present. Also referred to as sensitivity.
Water Quality Protection Plan (WQPP) - A plan developed by a large water supplier (50 million gallons/year or more) that describes how their sources of drinking water are threatened, and what steps are being taken to protect them. This has been superseded by the Water Supply System Management Plan (WSSMP).
Watershed - The high ground surrounding a surface water intake.
Water Supply System Management Plan - beginning January 1999, the Plan required of the State's large water suppliers that will supersede the Water Quality Protection Plan.
Wellhead Protection Area (WHPA) - The surface of a three-dimensional volume around a wellhead that contributes water to the well.
Wellhead Protection Plan (WHPP) - A plan accepted by RI DEM that explains how a supplier or municipality will regulate activities with its WHPA to protect drinking water. Also the Wellhead Protection Program, as administered by DEM's Groundwater Section.

Appendix 2 - Public Advisory Committee
List of People and Groups Invited:

Northern RI Conservation District
RI Farm Bureau Federation, Inc.
Green Party of RI
RI Project AIDS
RI Council of Churches
Southern RI Conservation District
RI Association of Realtors
Wood-Pawcatuck Watershed Alliance
Environment Council of RI
Clean Water Action
Eastern RI Conservation District
RI Public Health Association
RI League of Cities & Towns
RI Builders Association
R. C. Diocese of Providence
Narragansett Indian Tribe
Audubon Society of RI
Kingston Water District
The Nature Conservancy
League of Women Voters
Ocean State Action
Atlantic States Rural Water Association
Kent County Water Authority

Public Advisory Committee
Summary of Comments and Concerns

The Committee had four primary concerns, revolving around public involvement.

1. The Committee expressed concern that certain groups were under-represented on the Public Advisory Committee itself, e. g. water suppliers and town government. The Committee was satisfied that these groups had been invited and would be kept informed during the preparation of the SWAP and during the assessment process. The Committee also wanted to see more public involvement on the Technical Advisory Committee. Thereafter, all meeting notices were sent to members of both committees.
2. The Committee wanted to see an outreach effort before the formal public hearing. To this end, the State contracted to hold three public meetings, with the assistance and support of the Committee. While the turnout was low at all three, it was generally felt that the effort was worthwhile.
3. The Committee felt that the State should attempt to make use of local knowledge in preparing the Source Water Assessments, and to inform the residents and consumers of assessments in process. With guidance from the University of Rhode Island's Cooperative Extension, we have decided to convene local committees to assist with the assessment process. This will address both of these concerns.
4. The Committee wanted assurance that the SWAP effort would lead to protection, and was concerned that there are no protection or enforcement mechanisms. The State explained that protection authority resides with local government. The State feels that the local committee approach will serve to inspire local protection efforts.

Questions Asked of the Public Advisory Committee

Keeping in mind that the Source Water Assessment Program is for the benefit of the Public Water Suppliers, these are the questions (paraphrased) that EPA in its guidance suggests that we consider:

Public Participation

A. Should the State do more to provide adequate opportunity to Stakeholder Groups to participate? How?

B. Should the State do more to receive recommendations from the Public Committee? How?

A. & B.: Regional and/or local informational meetings must be held before the Plan goes to formal public hearing. Local non-profit groups can be tapped for their mailing lists and organizational capabilities, and to facilitate the meetings; feedback from these meetings should be incorporated into the Plan.

C. What should the State do to provide for ongoing public participation? *High school students or youth from other organizations can be recruited to assist, with guidance, in inventories where such information is lacking. The same kinds of non-profits mentioned above can lead informational meetings as the assessments proceed, soliciting feedback as to the format and methods of distribution of the finished SWA's.*

Public Availability

A. What should be included in the assessment results, what should be the format, when should they be made available? How will the results of the assessments be characterized (e. g. high, medium, low; or most important through least important)?

B. When all of the results of an assessment are requested, how and when should they be made available?

C. What types of maps should be available to display assessment results?

D. How should the State or Supplier provide wide notification of the availability of the assessments and other information collected?

Implementation

A. Should the State delegate aspects of the SWAP program? Which aspects, and to whom?

- Refinement of delineations – USGS has submitted proposals
- Data review – The Department of Health and DEM have the data in hand and the capability and familiarity to assess data.
- Assessments – Water Suppliers already have some responsibility to gather data (inventories). Self-assessments (with guidance and oversight) have been suggested for Transient Non-Community suppliers.
- Outreach - Non-profit groups such as watershed associations, Audubon Society, Conservation Commissions, Soil Conservation Districts, etc. can be contracted to lead meetings that will keep interested parties up to date on the progress of SWA's in their areas. These meetings could generate feedback on what more could be done, how the approach could be fine-tuned, how the public could be more involved, or how the final SWA could be presented or distributed.

A. How should state agencies coordinate with each other, with the Federal government, and with local stakeholders when implementing the SWAPs?

Contact should be made early with MA and CT concerning cross-border Source Water Protection Areas.

B. When and what should the State report to EPA regarding SWAP implementation?

When and how should PWSs update assessments?

A. CWA 305(b) reports every five years, includes drinkability standards
SWA's should be a formalized part of the 305(b) report, and updated accordingly, at least for the major water suppliers.
B. WHP Program Updates from DEM every two years
C. Sanitary Surveys every 5 years
D. WSSMPs every 5 years
E. Testing Waivers renewed every 3 years, for those who have them.

Appendix 3 - Technical Advisory Committee

Members:
Rob Adler, US EPA Region 1
Jim Campbell, US Geological Survey
Ray Church, RI Public Utilities Commission
Michael Covellone, Providence Water Supply Board
Fred Crosby, Providence Water Supply Board
Wayne Jenkins, RI Dept. of Environmental Management
Lorraine Joubert, URI Cooperative Extension
Alyson McCann, URI Dept. of Natural Resources Science
David McCurdy, Atlantic States Rural Water Association
Ernie Panciera, RI Dept. of Environmental Management
Eugene Pepper, RI Dept. of Environmental Management
Will Riverso, Water Resources Board
Elizabeth Scott, RI Dept. of Environmental Management
Emanuel Souza, US EPA Region 1
June Swallow, RI Department of Health, Office of Drinking Water Quality

Technical Advisory Committee
Summary of Concerns
It is not really possible to reduce the Technical Advisory Committee's activities to a simple list of concerns, since their joint expertise is embedded in the SWA Plan as it now exists. The primary areas discussed were as follows:
1. Delineations, and priorities for refining delineations, received special attention. A list of WHPA's was made, according to explicit criteria, to be targeted for refinement. USGS has submitted proposals to do this work.
2. Available data for land-use inventories were identified, along with the shortcomings of the various databases.
3. The issue of ranking threats of different types was discussed at length. It came down to the general feeling that while much information can be delivered in tabular form, it is the narrative and public outreach that will put threats into the perspective of amenability to mitigation.
4. Several hours were spent discussing soil type ranking. It was finally established that a modified version of NRCS's hydrologic soils groups, as used by URI's Cooperative Extension, would be adopted for SWAP. The modifications involve permeability of the subsoil, proximity to surface water, and depth to water table.
5. The Committee discussed the desire of large suppliers to do their own assessments. Only a few systems have indicated an interest in doing their own assessments, and have the hardware, software and expertise to produce assessments of the type we are proposing. In the interest of simplicity and uniformity, the state has a preference to work with a single contractor to

produce assessments for all of the large systems. We have therefore offered a compromise in which a committee will be formed for each of the large suppliers, that will include the supplier, representatives of local government, the Departments of Health and Environmental Management, the assessment contractor, and local citizens' groups. This committee will, within the structure of the EPA-approved SWAP, provide advice and guidance for the assessment process, including determining the necessity for extensive inventory effort. So far, the large systems have indicated an acceptance of this proposal.

Appendix 4. Large Water Suppliers

This list includes water suppliers who produce at least 50 million gallons per year. They are required to file Water Quality Protection Plans with the Water resources Board. Suppliers who purchase water are not included.

Bristol County Water Authority
Town of Cumberland
Harrisville Fire District
Kent County Water Authority
Kingston Water District
Newport Water Authority
Town of North Kingstown
Pascoag Fire District
City of Pawtucket
RI Port Authority
Providence Water Supply Board
Town of South Kingstown
Stone Bridge Water District
United Water (Wakefield)
City of Westerly
City of Woonsocket

Other suppliers may soon be added to this list, including the University of Rhode Island and the Town of Richmond.

Appendix 5. A Vulnerability Assessment of Public-Supply Wells in Rhode Island, By Leslie A. DeSimone, U.S. Geological Survey, 28 Lord Road, Suite 280, Marlborough, MA 01752

Statistical analysis of water-quality data from 256 public-supply wells and of available hydrogeologic, land-use, soil-type, cultural, and other spatial data is being used to identify factors that contribute to the relative vulnerability to contamination of public-supply wells in Rhode Island. The study is being conducted by the U.S. Geological Survey in cooperation with the Rhode Island Department of Health. The assessment includes all active community and non-community, non-transient supply wells in Rhode Island. These wells withdraw water from stratified-drift aquifers (94 wells), bedrock aquifers (154 wells), and aquifers of indeterminate type (8 wells). Water-quality data consist of monitoring results for compliance with Safe Drinking-Water Act regulations for the period 1988 to 1996 and were obtained from the digital database maintained by the RI Department of Health. Spatial data include digital data layers that were obtained and, in some cases, modified from the Rhode Island Geographic Information System (RIGIS).

Relative vulnerability to contamination, which is defined as a function of hydrogeologic characteristics and contaminant use in the vicinity of the aquifer or supply well (U.S. Environmental Protection Agency, 1993), is assessed with respect to multiple classes of monitored drinking-water contaminants. These classes are based on potential sources of contaminants and are defined as nutrients, solvents and other industrial organic compounds, fuel hydrocarbons, pesticides, road-deicing chemicals, fluoride, iron and manganese, trace inorganic chemicals (such as metals), fluoride, and microbial contaminants. For each contaminant class, a threshold criterion is determined by which to categorize well water as "affected" or "unaffected" based on the historical water quality at the well. Generally, this threshold value is considerably less than the U. S. Environmental Protection Agency and State of Rhode Island drinking-water standards but is chosen to indicate the effects of any human activity or natural contaminant source.

Simple statistical tests, contingency tables and the Mann-Whitney test (MW), are used to compare well characteristics, hydrogeologic variables, and spatial data in wellhead-protection areas (WHPAs) between affected and unaffected groups of wells. The WHPAs, which were delineated by the Rhode Island Department of Environmental Management (Bradley and Kaczor-Babiak, 1993; Rhode Island Department of Environmental Management, 1995), are considered to be the best available representations of the land-surface areas that contribute water to the wells. Thus, the WHPAs define the area within which contaminant sources or hydrogeologic characteristics are likely to affect water quality at the well. Spatial data used in the analysis include GIS data layers for land use, surficial and bedrock geology, soil type, road density, surface-water hydrography, and known waste sites. Variables with statistically significant differences between affected and unaffected well groups are identified as indicators of a well's likelihood of being affected and as potential factors contributing to a well's vulnerability to contamination.

Preliminary results indicate that land use in a WHPA and aquifer type are the best indicators of potential contamination for several contaminant classes. For nutrients, affected wells and associated WHPAs are defined by nitrate concentrations greater than 1 milligram per liter as nitrogen. Residential land use and an urban land-use type that includes parks and golf courses, as areal percentages of the total WHPA, are found to be significantly higher in WHPAs with wells that were affected by nutrients than in WHPAs without nutrient-affected wells (MW, *p*-values less than 0.05); in contrast, the areal percentage of agricultural land use in a WHPA was not significantly different between affected and unaffected groups. These results also were

found using a threshold criterion of 5 milligrams per liter as nitrogen. For solvents and other industrial organic compounds, for which the threshold criterion consists of any detectable concentration, the areal percentage of industrial land use were significantly higher in affected WHPAs than in unaffected WHPAs. For pesticides, the most significant land uses were the urban land use type that includes parks and golf courses and institutional land use; median nitrate concentrations at the well also were higher in pesticide-affected wells. For fuel hydrocarbons, no land-use type was significantly different between affected and unaffected groups. Wells screened in stratified-drift aquifers were more likely than bedrock wells to be affected for three of these four contaminant classes. Other hydrogeologic variables, such as the depth to water, depth to bedrock, and type of surficial deposits overlying bedrock wells, generally were not significantly different between affected and unaffected groups; however, this result may be due to the limited amount of available data for some wells. As part of the study, the significant variables for each contaminant class will be tabulated for all 256 supply wells to evaluate the relative vulnerability of the wells with respect to the contaminant classes.

The results of this study may be used in several ways to support source-water protection in Rhode Island. Identification of the land use and other variables that are associated with potential contamination may be used as a screening tool to identify public-supply wells that may be at risk. The analysis also may be used on a statewide basis to determine the relative importance of some of the explanatory variables. For example, the preliminary results indicate that urban land uses are more likely than agricultural land uses to be associated with elevated nitrate concentrations in Rhode Island. Finally, results of this study could be used to direct data collection and analysis towards developing additional approaches to vulnerability assessment that are more quantitative and predictive.

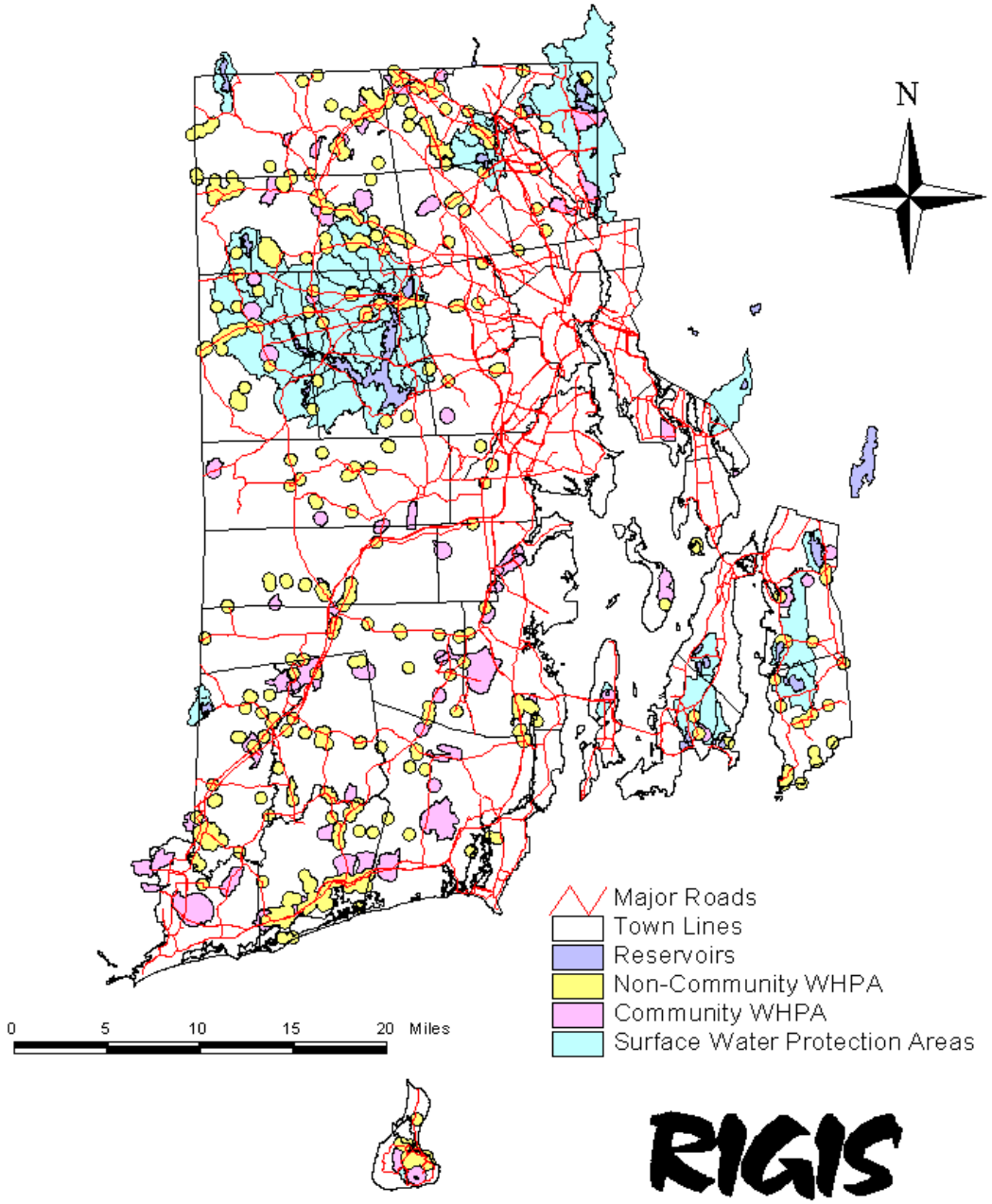
References

Bradley, M.D., and Kaczor-Babiak, S.M., 1993, *WHPA delineation methodology for public drinking water wells in Rhode Island*: Rhode Island Department of Environmental Management, Division of Groundwater and ISDS, Providence, RI, 15 p.

Rhode Island Department of Environmental Management, 1995, *The Rhode Island wellhead protection program, biennial report, October 1993-September 1995*: Rhode Island Department of Environmental Management, Division of Groundwater and ISDS, Providence, RI, 24 p.

U.S. EPA, 1993, *A review of methods for assessing aquifer sensitivity and ground water vulnerability to pesticide contamination, September 1993*: U.S. EPA, Office of Water, Washington DC, EPA 816-R-97-007, 106 p.

Appendix 6.
Rhode Island's Source Water Protection Areas



Appendix 7. Excerpted from RI DEM Wellhead Protection Program Biennial Report, September 1997. The entire text can be obtained from Rhode Island DEM, Office of Water Resources, at (401) 222-2234.

Delineation of Wellhead Protection Areas

Rhode Island was the first state in the nation to complete delineation of all its wellhead protection areas. Mapped by DEM hydrologists, these initial delineations were provided to each large water supplier and each municipality in 1993. The delineations are based on reasonably available information regarding the hydrogeologic environment and the well characteristics.

The WHPAs are delineated using the US Geological Survey quadrangle maps (1:24,000). WHPA maps at this scale are available for review at the DEM Office of Water Resources. DEM uses the RI Geographical Information System (RIGIS) extensively in the delineation of the WHPAs and in preparation of maps for local governments and water suppliers. In 1997, DEM updated the state wellhead protection area map. Formal adoption of the map and incorporation into the state groundwater classification system as an amendment to the DEM "Rules and Regulations for Groundwater Quality" is pending.

The WHPAs cover approximately 13% of the state, or 92,757 acres. The largest WHPAs cover approximately 2,000 acres and the smallest ones approximately fifteen acres. The acreage designated for community wells is 36,161 or about 5.2% of the state's land area. The number of WHPAs varies regionally with the dependence on groundwater.

Charlestown, which has the largest number of public wells (eighty-two) of any community, also has the largest percentage of town land area designated as WHPAs (38%). Other communities with significant percentages of land area designated as WHPAs include New Shoreham (36%), North Smithfield (33%), Glocester (25%), Hopkinton (21%), Westerly (19%), and Richmond (19%). [Table 5 in the original document contains data on all Rhode Island towns.] WHPAs for several wells in Rhode Island extend across state boundaries into Connecticut and Massachusetts, resulting in 1,905 acres designated as WHPAs out of state.

Delineation Methods

For the community systems and the larger non-community systems (greater than ten gallons per minute), the WHPAs were delineated using a mathematical model in conjunction with mapping based on the hydrogeologic characteristics in the area. The approach differed depending on whether the well was withdrawing water from bedrock or from stratified drift. The maximum extent of the WHPAs in the upgradient direction of groundwater flow for most of the larger wells is between one-half mile and two miles.

For wells in stratified drift, the uniform flow equation was solved using the MWCAP module of the Environmental Protection Agency WHPA model software to generate a curve showing that portion of the stratified drift which contributes water to the well. In a typical mapping scenario, the curve was extended to the boundary between the stratified drift and till deposits. At this point, topographic contours were used in lieu of water table information to determine groundwater that flows into the curve. [See Figure 3 in the original document.]

Because of the difficulty in determining groundwater flow in bedrock, WHPAs for the larger bedrock wells were delineated using a circle generated by application of the Theis equation. Similar to stratified drift, topographic contours were used to determine groundwater that flows

into the circle.

Very little data is available for most of the smaller non-community wells, which account for approximately two-thirds of the public wells in Rhode Island. A circle with a radius of 1,750 feet, derived from a solution of the Theis equation, was used for the WHPAs for all of the transient and smaller non-transient non-community wells. Generalized input values based on published sources were used in the Theis equation resulting in the 1,750-foot radius.

Refined Delineations

Initial delineations provide a basis for local protection efforts. Ideally, the delineations for the community wells and perhaps some of the non-transient non-community wells, particularly the large wells, will be revised in the future using more site-specific data and possibly more complex methods. No determination has been made regarding the responsibility and scheduling of what DEM is referring to as "refined" delineations. Once accepted by DEM, a refined WHPA delineation will replace the initial DEM WHPA in all groundwater programs.

At present, DEM has adopted refined delineations for 20 public wells. These delineations address major public water supply wells in the Hunt aquifer in North Kingstown, East Greenwich and Warwick; the Town of North Kingstown's wells in the Annaquatucket Aquifer, and wells operated by local districts on Prudence Island and in Charlestown.

Appendix 8. EPA's Suggested Reporting Format

Table 1 : (Name of State) Source Water Assessment and Protection Reporting for Community Water Systems FY 2000-2005								
	Systems Using Ground Water Only		Systems Using Surface Water		Systems Using Both GW & SW Sources		**State Total**	
	Number of Systems	Popul. Served	No. of Systems	Popul. Served	Number of Systems	Popul. Served	No.of Syst.	Pop. Serv.
A. Total No. of CWSs or Popul. (from SDWIS)								
Level 1 Delineation								
Level 2 Source Inventory								
Level 3 Susceptibility Determination								
Level 4 Public Availability								
B. Total No. of CWSs or Popul with Levels 1-4								
% of Systems or % Popul w/ Assessed CWS (Levels 1-4) [(B÷A)x100]								
Level 5 Management Measures								
Level 6 Contingency Planning								
C. Total No. of CWSs or Popul with Levels 5&6								
% of Systems or % Popul w/ Prevention (Levels 5&6) [(C÷A)x100]								

Table 2 : (Name of State) Source Water Assessment and Protection Reporting for Non-Transient Non-Community Water Systems FY 2000-2005				
	Systems Using Ground Water Only	Systems Using Surface Water Only	Systems Using Both GW & SW Sources	**State Totals**
	Number of Systems	Number of Systems	Number of Systems	Total Number of Systems
A. Total Number of NTNC Water Systems in State (from SDWIS)				
Level 1 Delineation				
Level 2 Source Inventory				
Level 3 Susceptibility Determination				
Level 4 Public Availability				
B. Total Number of NTNC Systems with Levels 1-4				
% of NTNC Systems with Assessments (Levels 1-4) [(B÷A)x100]				
Level 5 Management Measures				
Level 6 Contingency Planning				
C. Total Number of NTNC Systems with Levels 5&6				
% of NTNC Systems with Prevention (Levels 5&6) [(C÷A)x100]				

Table 3 :(Name of State) Source Water Assessment and Protection Reporting for Transient Non-Community Water Systems FY 2000-2005				
	Systems Using Ground Water Only	Systems Using Surface Water Only	Systems Using Both GW & SW Sources	**State Totals**
	Number of Systems	Number of Systems	Number of Systems	Total Number of Systems
A. Total Number of TNC Water Systems in State (from SDWIS)				
Level 1 Delineation				
Level 2 Source Inventory				
Level 3 Susceptibility Determination				
Level 4 Public Availability				
B. Total Number of TNC Systems with Levels 1-4				
% of TNC Systems with Assessments (Levels 1-4) [(B÷A)x100]				
Level 5 Management Measures				
Level 6 Contingency Planning				
C. Total Number of TNC Systems with Levels 5&6				
% of TNC Systems with Prevention (Levels 5&6) [(C÷A)x100]				

Notes for Tables:

1. The Safe Drinking Water Act requires biennial reporting of State Wellhead Protection Program progress, however EPA must track progress on source water assessments and submit annual reports to Congress on source water protection efforts for community water systems. To meet these needs, States will submit accurate data to EPA Regional offices every odd-numbered year, but will submit estimated data for the even-numbered years. EPA regions should agree on a process with the states to create these estimates based on the previous years' data.
2. States report the information to EPA by system, not by individual sources. Generally, all sources for a particular system must meet that step to count the system. There may be exceptions, such as where an unprotected source is only used during unique situations such as drought conditions. This will be left to states' best professional judgement.
3. In Table 1, States do not need to submit data on the population served for each specific SWAP level (columns shaded in gray). However, they do need to show the total and percent population served by systems that meet all of the assessment Levels 1-4 (row B) and prevention Levels 5&6 (row C), for each source type and the total for the state. No population data is needed for non-community water systems.
4. Levels 5 and 6 are required by the Safe Drinking Water Act for systems under Wellhead Protection Programs, but are not required for surface water systems. However, they are the essential prevention elements of an overall source water protection program. A system will be counted as achieving source water protection once it has achieved Levels 1-6 regardless of whether it is a surface water or ground water system.
5. Where management measures and/or contingency plans were implemented prior to the completion of all assessment steps (Levels 1-4), states should report data for those systems in parentheses in Levels 5 and/or 6. Once the source water assessment information is completed and released to the public (Level 4), then the data can be reported without parentheses. Therefore, the data in Levels 5 and 6 may be shown both inside and outside parentheses while states are completing the assessments.
6. There is no clear national definition of SWAP Level 5 "Management Measures," and states prefer to have discretion in determining this step. The analogous Wellhead Protection Step 4 "Source Management" is described in the 1997 Wellhead Protection Program Biennial Report Guidance, and is counted once a state has "determined that the wellhead areas are protected from contaminants or potential contaminants which may have any adverse effects on the health of persons," and that "potential sources and actual sources of contamination are being managed in a manner that is consistent with the state's EPA-approved Wellhead Protection Program." States probably interpret the WHP Step 4 in different ways. However, EPA recommends that both ground water and surface water sources should be protected with an array of prevention measures. For instance, basic recommended elements for SWAP Level 5 could include the formation of a local team that moves the community's protection program forward and other local involvement and outreach measures, local regulations or programs that control sources of contaminants such as septic tank requirements or best management practices for businesses, implementation of local comprehensive plans or zoning that protect drinking water sources, and differential state regulatory program implementation in source water areas targeting underground storage tanks, class V wells, etc.

Appendix 9. Source Water Assessment and Public Education

Coordinating the Rhode Island Home*A*Syst Program with the State's Source Water Protection Efforts

Project Justification

INTRODUCTION

The University of Rhode Island Cooperative Extension Home*A*Syst Program proposes to assist the Rhode Island Department of Health in its Source Water Assessment Program efforts by assisting with source water assessments and public education and outreach for the State's major water supplies. We propose to develop an approach for the Rhode Island Home*A*Syst Program to train program volunteers to conduct source water assessment inventories within the watersheds and wellhead areas of the state's largest water suppliers. In the first year of this project we will adapt RI Home*A*Syst training materials for use in source water assessment efforts, train volunteers, and conduct assessments and public education workshops in several areas. Based on work with the pilot materials, we will revise and produce a final volunteer training manual for use in additional assessments in the following two years.

The proposed project is designed to assist the Rhode Island Department of Health in meeting the requirements of the Source Water Protection Program under the 1996 Amendments to the federal Safe Drinking Water Act. The RI Department of Health has approached URI Cooperative Extension's Home*A*Syst Program to assist with the Source Water Protection Program. Because of Extension's history of training volunteers and maintaining a volunteer base to achieve community-based goals and objectives, we are in a unique position to assist the Department of Health in these efforts. One of the overall goals of the RI Home*A*Syst Program is to serve as the model program for accomplishing residential pollution prevention within the state. This proposal furthers these efforts.

Rhode Island's Source Water Protection Program

The Source Water Protection Program was established by the 1996 Amendments to the federal Safe Drinking Water Act (SDWA). Its stated purpose is to assess the threats to our sources of drinking water, "for the protection and benefit of public water systems, and to support monitoring flexibility". In Rhode Island, the Office of Drinking Water Quality in the Department of Health has the responsibility of implementing the program. This office regularly inspects all public water systems to ensure that the water delivered to the public meets all of the standards set by the US EPA. Rhode Island has had very high quality water over the years, but contamination has occurred from the sources addressed in the Source Water Protection Program. The goal of the program is to predict and prevent such contamination in the future.

It is generally recognized that protecting the quality of drinking water is cheaper than treating water after it has been contaminated. The Source Water Protection Program is intended to make suppliers, planners, developers, residents, and others aware of the threats to the future quality of their drinking water, so that we may take action before contamination occurs**.** Source water protection is seen as the most cost-effective way of assuring safe drinking water.

In accordance with the SWAP requirements, the Rhode Island Department of Health has the responsibility to:

- Provide an inventory of all potential sources of contamination that use, store, or generate pollutants that are considered risks to human health;
- Assess the risk to public health and water quality impairment from these sources of contamination, and rank the threats within each protection area;
- Make the results of the assessments known to water supply consumers.

The Rhode Island Department of Health has proposed in its draft Source Water Protection Plan to conduct Tier 1 and 2 assessments of public drinking water supplies. (A public hearing on this draft SWP plan is scheduled for January 26, 1999. After which time, the plan will be submitted to EPA for final approval.) The RI Department of Health (DOH) will conduct a Tier 1 assessment of wellhead protection areas (WHPAs) for small community wells and non-community wells. The goal of the Tier 1 assessment is to rank the pollution risk to these WHPAs on a scale from low to high risk through an inventory of pollution sources, distance from pollution sources to the well, land use risk rating from low to high, and risk of pollution movement based on soil features.

Tier 2 assessments will be conducted for the state's large water suppliers – those that pump more than fifty million gallons per year. Tier 2 assessments will be more complete and in-depth. The DOH will convene a local committee to provide advice and local knowledge for the assessment process. The committee will include a representative from the water supplier, the DOH, the Department of Environmental Management, the RI Water Resources Board, the municipalities served by the supplier and those within the watershed or wellhead area of the supply source, and citizen groups or individuals.

Incorporating the Rhode Island Home*A*Syst Program into Source Water Protection Efforts

Rhode Island Home*A*Syst will assist in the Tier 2 assessment procedures and the public education and outreach component of the Source Water Protection Plan. The DOH has specifically mentioned RI Home*A*Syst in its draft plan, which can be found at http://www.health.state.ri.us/environment/swaphome.htm

It is difficult and expensive for public water supply systems to keep up with new threats to drinking water and new standards for monitoring and treatment. Prevention is effective to protect drinking water from pollutants and can help to reduce the financial burdens of insuring safe drinking water. With the 1996 Amendments to the Safe Drinking Water Act, public officials are targeting pollution prevention as the first step in a multi-tiered approach to public drinking water protection. Local groups have limited time and can be best served by identifying result-oriented activities that will generate multiple benefits, including direct actions that protect drinking water through pollution prevention. There are many incentives for water suppliers to invest in prevention. Pollution prevention:

- avoids the costs of cleaning up contaminated drinking water supplies,
- reduces compliance costs by minimizing monitoring and treatment obligations,
- limits exposure to lawsuits resulting from poor water quality, and
- increases consumer confidence in the water supply.

The Rhode Island Home*A*Syst Program provides an action-oriented approach to protect water quality. The program is a voluntary residential pollution prevention program that trains residents to protect their health and environment. Home*A*Syst, or Home Assessment System, offers a procedure to assess environmental risks around the home and take actions to correct any identified problems. The program has a long history of cooperation in conducting educational programs on private well protection, septic system maintenance, wetland buffer landscaping, and other pollution prevention topics with the RI DOH, RI Department of Environmental Management, and a number of other local agencies and organizations.

The program contains a multi-tiered approach to pollution prevention, which includes:

1. A volunteer training component consisting of a multi-session educational workshop series. Volunteers are trained to help other residents, either statewide or in pilot neighborhoods, to conduct homesite assessments and to develop action plans to address identified problems. Volunteers receive training in areas such as drinking water well protection, septic system maintenance, lawn and garden care, managing stormwater runoff and backyard wetland riparian areas, waste management, and water conservation. We have offered this program annually since 1997 and have trained 40 individuals who have contributed over 200 hours of volunteer time.

2. Community workshops focusing on pollution prevention and the protection of private drinking water supplies. We began offering Home*A*Syst workshops in Rhode Island in 1996 as the national office coordinated the development of the handbook materials. These local workshops focused on the protection of private drinking water wells and the proper operation and maintenance of on-site septic systems. We continue to offer these two workshops in communities throughout the state 8 - 12 times annually. Since the development of the Home*A*Syst handbook, we have expanded the topics offered. Attendance at these community workshops averages 25 people. These workshops are offered in conjunction with the RI Dept. of Health and the RI Dept. of Environmental Management. Local community groups host the workshops. Some examples of groups we work with include: municipal Conservation Commissions, Rhode Island Conservation Districts, public water suppliers like Providence Water, and local, nonprofit watershed associations.

3. A quarterly RI Home*A*Syst newsletter containing program updates, pollution prevention techniques and best management practices, new resources and information, and volunteer opportunities.

4. Displays and educational materials have been developed for community events and local library distribution. In addition, every library in the state has received a copy of the RI Home*A*Syst Handbook.

5. Information and pollution prevention techniques are distributed over the World Wide Web on the RI Home*A*Syst web page at http://www.edc.uri.edu/homeasyst.

6. Over the past year, we have been successful in obtaining additional funding for program

development including:

- Funding from USDA, CSREES to develop a model chapter for Home*A*Syst addressing the concerns of consumers of public water and source water protection efforts in underserved communities.

- Funding from the RI DOH to assist in the development and implementation of a community-based Brownfields redevelopment chapter modeled after the RI Home*A*Syst materials.

- Funding from U.S. EPA, Region 1, Resource Protection Project to educate residents and renters in the Coastal Ponds Watershed area about septic system operation and maintenance.

- Funding from the RI Department of Environmental Management to conduct homeowner education programs at the On-Site Wastewater Training Center.

Through this project we propose to apply Cooperative Extension's experience in soliciting, training, and coordinating citizen volunteers to assist in developing locally led source water protection efforts. RI Home*A*Syst will organize and train volunteers to assist in conducting pollution source inventories for large water supplies and to conduct public outreach upon completion of the assessments. Our intent in involving citizen participation in the assessment process is multi purpose, with several advantages, as outlined below:

- **Tap into local knowledge.** Residents of the source water supply watershed or wellhead protection area are often the most knowledgeable about existing or past land uses and potential sources of contamination. Involving citizens in identifying these pollution sources is often the most efficient way to update existing land use information and to evaluate pollution risks from historical activities.

- **Raise public awareness of pollution risks.** Residents of the source water area have a stake in maintaining source water quality to protect the overall quality of life in their community. Because nonpoint sources of pollution associated with land use activities in the watershed or WHPA often present the greatest threat to the long-term quality of water resources, effective source water protection often depends on local government land use decisions and residents' personal pollution prevention actions. Given the need for local action to protect source water areas, involving citizens in the assessment process from the beginning will raise local understanding of pollution risks and protection needs, as well as increase individual awareness of pollution threats originating on residential property.

- **Build support for local adoption of management practices.** Citizen volunteers working to inventory and update land use will be invited to participate in identifying locally acceptable management practices. By providing feedback on local attitudes and preferences, citizen volunteers will provide valuable assistance to the advisory group in developing source water protection strategies.

- **Develop effective outreach methods.** Volunteers serving on the advisory group and those conducting assessments will serve as a sounding board for identifying effective methods to distribute assessment results to water supply users. Citizen volunteers will be invited to assist in developing an outreach strategy for publicizing assessment results through participation in the local advisory group and surveys. Local input will be sought on the

most effective communication mediums, delivery methods for various target audiences, and messages to promote both voluntary pollution prevention and municipal actions to protect source water areas. Volunteers will also assist in educating community members on assessment results and residential pollution prevention techniques.

- **Connection to national support network.** RI Home*A*Syst is part of a national program supported the USDA Cooperative State Research Education and Extension Service (CSREES), the USDA Natural Resources Conservation Service (NRCS), and the U.S. Environmental Protection Agency (EPA). One product of this support network is the Home*A*Syst environmental risk-assessment guide for the home that has been adapted for Rhode Island. RI Home*A*Syst will be coordinating SWAP activities with other Cooperative Extension Home*A*Syst programs developing volunteer-supported SWAP programs in other states. Educational materials, training methods, and outreach strategies developed through the efforts of this approach can serve as a model for other states.

Project Description – Objectives, Procedures, Outputs, and Outcomes

Connection with CSREES' Strategic Directions for the Water Quality Education Program: FY1998 and Beyond

In January 1998, CSREES released a strategic plan outlining critical elements of the Water Quality Education Program for 1998 and beyond. The strategic plan contains seven goals for the water quality program. How this project addresses these goals is outlined below.

Goal 1: Increase the delivery of education programs about water quality, water-related health risks, and waste treatment systems in underserved communities.

In Rhode Island's 1998 GPRA, the water quality program identified "underserved" communities as the following: Central Falls, Woonsocket, Pawtucket, Providence, West Warwick, Charlestown, East Providence, Westerly, Newport, Cranston, South Kingstown, Burrillville, and Tiverton. Tier 2 assessments are planned for water systems within our programs "underserved" communities. Within the Project Schedule and Tasks section of the proposal is outlined the systems and the communities served.

In addition, URI Cooperative Extension Home*A*Syst Program received funding from CSREES in 1998 to develop a Public Water Assessment Method for Underserved Communities Using the Home*A*Syst Approach. The purpose of this project is to develop a companion chapter to the Home*A*Syst handbook to address the concerns of underserved communities in regards to public drinking water supplies by addressing both consumer concerns and source water protection issues within residential areas. These materials will be incorporated into the outreach efforts of this project.

Goal 2: Develop and deliver education programs that teach the hydrologic functions and the dynamics of watersheds and aquifers, enabling landowners and policy makers to protect the quantity and quality of the Nation's water resources.

RI Home*A*Syst educates individuals by providing site-specific information set in the context of the hydrologic dynamics of their communities and the watersheds in which they live. Rhode Island Home*A*Syst workshops consist of a demonstration using a groundwater model illustrating watershed functions, basic groundwater movement, the interaction of ground and

surface water, the state's aquifer types, pollution movement. In addition, slide presentations, table top displays and local community watershed maps are used in educational programming to illustrate site specific information and conditions for the communities in which the workshops take place. The RI Home*A*Syst handbook is utilized in the workshops. The Handbook's first chapter on site assessment increases a resident's understanding of how soil types and geologic conditions either contribute to, or help control, water pollution risks. Combined with the results of other worksheets, the information about site conditions provides a comprehensive view of pollution risks unique to a property. Through the process of self-assessment, residents discover how environmental conditions around the home can affect environmental quality. This can help build the motivation for residents to adopt best management practices and conservation techniques.

Goal 3: Increase the public's knowledge of pollution prevention control systems and of personal actions that they can employ to conserve and protect stream systems.

Home*A*Syst encourages residents to take actions to minimize identified pollution risks and provides specific information on pollution prevention techniques. Using site-specific assessment tools, residents learn firsthand the consequences of pollution to their home and local environment. They are motivated to improve management to safeguard the health of their land and families and avoid environmental liability and cleanups. Surveys conducted by the National Office suggest that two-thirds of the many thousands of families who participate in the program make or intend to make low-cost changes immediately, with higher-cost actions planned for the future. This action-oriented approach to pollution prevention generates voluntary investments in the amount of approximately $700 per household. Surveys conducted in Rhode Island of individuals who have participated in Home*A*Syst programming have found that:

22% have tested their private drinking water supplies
73% implemented water conservation practices
72% began proper disposal of household hazardous wastes
29% have pumped their septic system
47% created a private wellhead protection area
60% tested their home heating oil tank for leaks.

Goal 4: Increase public understanding and involvement in community decision-making and in the creation of public policy on water resources issues.

Home*A*Syst builds this understanding through personal experience and involvement. Many types of information are needed to make responsible decisions. By systematically conducting assessments within watershed and wellhead protection areas of the state's larger water supplies, communities have a potent tool that combines prevention activities with the assessment of community-wide pollution risks. Using this technique, a community can gather data unavailable through other data collection methods. This information will result in a more accurate profile of pollution risks community-wide and set the stage for communities to more effectively target priorities for preventive action.

Home*A*Syst volunteers will be members of the local advisory groups and involved in the public outreach and education component of the Source Water Protection efforts. They will be educated and involved in community decision-making processes as water suppliers and communities move forward to protect drinking water supplies.

Goal 5: Develop and deliver educational programs that enable individuals to safeguard their own drinking water.

Home*A*Syst has distinguished itself as the only national initiative for helping 23 million private well owners protect their drinking water quality. The RI Home*A*Syst Program offers educational workshops on conducting private drinking water well assessments and action planning and empowers individuals to take voluntary action by building awareness of pollution risks to drinking water and identifying pragmatic actions to safeguard water quality. Specific worksheets focus attention on critical issues. We offer this information in our volunteer training program, at community workshops and events, in travelling educational displays, and on our program web page. In addition, the RI Home*A*Syst program is currently working on a new module addressing the concerns of consumers of public water and source water protection of public supplies. This new module will be incorporated in the work proposed here.

Goal 6: Promote youth and adult volunteers' involvement in protecting and enhancing the quantity and quality of the nation's ground and surface water.

The RI Home*A*Syst Program is committed to training community members as volunteers in the program. Utilizing Extension expertise in the train-the-trainer model enhances pollution prevention efforts within the state and broadens the base of an educated citizenry involved in source water protection efforts. We have had two successful years of volunteer training and management and have trained 40 program volunteers to date.

Goal 7: Develop and maintain partnerships for more effective and sustained solutions to long-term water quality and quantity issues.

The Rhode Island Home*A*Syst Program has been developed as a collaborative effort with federal, state, and local agencies and organizations from the start. Partnership agencies include: The Rhode Island Department of Health, the Rhode Island Department of Environmental Management, Rhode Island Resource Recovery Corporation, USDA Natural Resources Conservation Service, the Rhode Island Conservation Districts, watershed associations, and municipal governments. These agencies and organizations participate as trainers in the program, host local workshops, and participate as volunteers.

Project Objectives

The objectives of this project are to:

1. Adapt the current Rhode Island Home*A*Syst Program to develop a model program which assists the RI Department of Health with its source water assessment efforts.

2. Train Home*A*Syst volunteers to conduct source water assessments and provide public outreach and education to citizens within the watersheds and wellhead protection areas of the state's public water supplies.

3. Develop a volunteer community outreach strategy which incorporates the assessment results and approaches for program volunteers to deliver residential pollution prevention education.

Because the goal of the assessment is to direct water supply protection actions, public participation will be integrated into the assessment process from project inception. This will be accomplished by establishing a broad-based local advisory committee representing diverse watershed interests for each major water supply area evaluated. This process will attract participants that are focused on local water resources, impacts to those resources, and both short and long-term actions needed to protect those resources. The role of this group will be to

advise and participate in the project. It will consist of water suppliers (who will have the option of chairing the committee), municipal representatives, citizen groups, interested watershed residents, and others who have both the interest and authority to adopt protection measures long after the assessment is completed and filed away.

The need for local involvement in the assessment process is particularly critical in major wellhead protection areas and large surface watersheds where nonpoint sources of pollution on privately owned lands are the major threat to water quality. In these areas, municipal land use policies, land development standards, and private landowners' actions are critical to the long-term integrity of aquifers and reservoirs. Involving municipal officials, watershed groups, and neighborhood association members, with water suppliers from the start of the project will allow all concerns to be addressed where possible through project design. Common interests such as protecting private wells and preserving open space that are consistent with source water protection can also be identified. By conducting the assessment in cooperation with groups who are responsible for managing land use in the source water area, the assessment will be designed to generate results that are useful to decision makers. The management options developed will focus on those that a community will most realistically be able to implement. Most importantly, management actions discussed and developed by the group are likely to have broader support than those developed without local consensus.

URI Cooperative Extension will assist DOH in coordinating project activities with the local advisory group for each major water supply assessment area. This will include developing the scope of work for each assessment in cooperation with the advisory group, responding to group recommendations and information needs throughout the assessment process, obtaining group input at critical stages of the assessment, and seeking advisory group guidance in developing the format of the final report and presenting findings to local decision makers and the general public.

In each major source water supply area receiving a Tier 2 assessment, RI Home*A*Syst will solicit and train a group of citizen volunteers to conduct assessments and provide outreach and information to the public on residential pollution prevention. Volunteers will be drawn from community groups such watershed associations, municipal boards and commissions, civic and neighborhood associations, and other interested local groups. Volunteer training will be conducted as a pilot program in the first year of the project, using a small test group to develop training methods and materials, and field-test the approach. The pilot program will be used to develop: strategies for organizing and communicating with volunteers; training materials in conducting the field inventories and mapping; methods to display draft and final results; coordination with existing groups such as local Conservation Commissions, and coordination with the local advisory committee overseeing the assessment process will be tested with a small group. Training methods and materials will be revised based on experience gained in pilot program. A volunteer training manual will be developed for use in working with volunteers in other assessment areas as a result of this pilot year work. Continuation of the project in additional watersheds and wellhead areas beyond the pilot year phase will be contingent upon available funding.

To conduct watershed and wellhead area assessments, volunteers will:

- Be trained in watershed concepts and nonpoint and point source pollution threats to surface water reservoirs and groundwater resources.

- Be trained in current best management practices for residential pollution prevention and ways in which to communicate this knowledge to audiences within the project areas.

- Be provided with the training and resources to conduct inventories in the watersheds and wellhead areas of the state's largest public drinking water supplies.

- Conduct pollution source inventory where information is currently unavailable. Field inventories will be conducted using the most current available land use maps.

The results of the assessments will be incorporated into URI Cooperative Extension's watershed assessment tool – MANAGE – to predict pollutant impact and high-risk areas. Results of the MANAGE analysis will be incorporated into public education and outreach materials. This work will be funded by other sources.

One of the primary objectives of the Source Water Protection *(Assessment)* Program is to make results of the assessment available to water supply users. This means summarizing results in an attractive format that will invite review by average citizens. The summary must be clear, concise, and easy-to-understand, perhaps using non-traditional media. Through a variety of programs, Cooperative Extension and the RI Home*A*Syst Program has gained extensive experience in making scientific information accessible to non-technical audiences. In cooperation with the Public Advisory Committee we propose to apply this experience to assist the DOH in developing an outreach strategy that will accomplish these objectives while also building upon the capabilities of existing outreach programs. Methods for distribution of assessment results will include the following:

a. Outreach strategy.

URI Cooperative Extension and Home*A*Syst volunteers will actively participate in development of an outreach strategy in cooperation with the Public Advisory Committee. This strategy will identify outreach message(s), target audience(s), format and medium for summarizing results, and will identify distribution methods. Information that will be used to develop the strategy will be provided by members of the advisory committee and the supplier, and may include: characterization of water supply consumers (from water supplier records and census data), information on minority populations served, home ownership, water use patterns, and existing outreach programs active in the source water area.

b. Public presentations.

Public presentations and workshops will be held for local decision-makers and the general public in each source water protection area. These programs will present the results of the assessments. Program volunteers will provide Home*A*Syst information and incorporate the public drinking water chapter that is currently being developed with funding from CSREES into the presentations, as well as the Rhode Island Home*A*Syst handbook.

c. Web access.

Results of the assessment, including pollution source mapping and pollution prevention techniques, will be made available through the URI Cooperative Extension and DOH web sites. This will include project methods, summary findings, and technical documentation for each source water protection area. In addition GIS maps will be available for review with GIS project data available to download for use with either ArcView software or ArcExplorer browsing software.

PROJECT PROCEDURES

Project tasks, persons responsible, and schedule for completing the tasks are outlined in the attached project task/ timeline table. We propose to conduct the pilot phase of this project during year one on the first three water systems listed below in the assessment areas chart. Based on continuation of the project in subsequent years and available funding, we will continue in areas listed below. This schedule is preliminary and subject to change based on needs of water suppliers. DOH may also augment this list to include several small community or non-transient, non-community wells. A final, complete list will be prepared in conjunction with the DOH.

A. Assessment areas

Water Systems	Community(ies) Served by System	Community(ies) within System's Watershed or WHPA	Timeline
Harrisville	Harrisville	Harrisville	YEAR 1 (MAR, 2000 – NOV, 2000)
Pascoag	Pascoag	Pascoag	YEAR 1 (MAR, 2000 – NOV, 2000)
Newport	Newport, Middletown, Portsmouth	Middletown, Portsmouth, Tiverton, Little Compton	YEAR 1 (MAR, 2000 – NOV, 2000)
Providence Water	60% of the state's population receives their drinking water from this supply source	Glocester, Foster, Scituate, Johnston, Cranston	YEAR 1 (MAR, 2000 – NOV, 2000)
North Kingstown, RI EDC	North Kingstown, Quonset/Davisville	North Kingstown, East Greenwich, Warwick	YEAR 2 (DEC, 2000 – MAY 2001)
URI and Kingston	University of Rhode Island and Kingston	University of Rhode Island and South Kingston	YEAR 2 (DEC, 2000 – MAY 2001)
South Kingstown	South Kingstown	South Kingstown	YEAR 2 (DEC, 2000 – MAY 2001)
United Water Company	South Kingstown	South Kingstown	YEAR 2 (DEC, 2000 – MAY 2001)

Westerly; Wood-Pawcatuck Watershed	Westerly; Wood-Pawcatuck Watershed	Westerly; Wood-Pawcatuck Watershed	YEAR 2 (DEC, 2000 – MAY 2001)
Jamestown	Jamestown	Jamestown	YEAR 2 (JUN, 2001 – NOV, 2001)
Kent Co	Warwick, West Warwick, West Greenwich	Warwick, West Warwick, West Greenwich	YEAR 2 (JUN, 2001 – NOV, 2001)
Bristol County Water Authority	Bristol, Barrington, Warren	Bristol, Barrington, Warren	YEAR 3 (DEC, 2001 – JUN, 2002)
North Smithfield	North Smithfield	North Smithfield	YEAR 3 (DEC, 2001 – JUN, 2002)
Cumberland	Cumberland	Cumberland	YEAR 3 (DEC, 2001 – JUN, 2002)
Pawtucket	Pawtucket	Pawtucket	YEAR 3 (DEC, 2001 – JUN, 2002)
Lincoln	Lincoln	Lincoln	YEAR 3 (DEC, 2001 – JUN, 2002)
Woonsocket	Woonsocket, North Smithfield	Woonsocket, North Smithfield	YEAR 3 (DEC, 2001 – JUN, 2002)

B. Action Items and Timelines – Year 1. Nov 1999 – Nov 2000.

Objective 1: Adapt the current Rhode Island Home*A*Syst Program to develop a model program which assists the RI Department of Health with its source water protection *(assessment)* efforts.

Action Items:

1. Assist the RI DOH in assembling local advisory teams for each of the three pilot areas listed in the table above.

2. With the assistance of the local advisory teams, finalize procedure for conducting assessments *(inventories)*.

3. Develop a pilot RI Home*A*Syst training module for volunteer training component and educational materials for volunteers to conduct assessments.

4. Review and revise volunteer training materials based on results of year 1 pilot efforts. Finalize training manual and produce for work in additional watersheds and wellhead areas

in subsequent years.

Objective 2: Train Home*A*Syst volunteers to conduct source water assessments and provide public outreach and education to citizens within the watersheds and wellhead protection areas of the state's largest public water supplies.

Action Items:

1. Coordinate with neighborhood groups to organize volunteers.

2. Conduct one multi-session volunteer training program to train program volunteers who will be working in the year one pilot area.

3. Continue to organize and support volunteers and provide technical assistance to volunteer base throughout year 1 of pilot program.

4. Compile volunteer records and summarize results.

Objective 3: Develop a volunteer community outreach strategy, which incorporates the assessment results and approaches for program, volunteers to deliver residential pollution prevention education.

Action Items:

1. Program staff and volunteers will work with local advisory committees in each area to develop a public outreach strategy for disseminating the results of the assessments and information regarding residential pollution prevention.

2. Conduct at least one public outreach workshop for community members in each of the three assessment areas during year 1.

Project Output Indicators

- The volunteer training component and public education workshops will educate participants on best management practices for residential pollution prevention. The public education workshops within each assessment area will focus specifically on identified residential pollution problems and concerns and what individuals can do to minimize those problems.

- Issues of the RI Home*A*Syst newsletter will focus on assessment results and promote residential pollution prevention practices for each area.

- Citizen volunteer training and coordination through RI Home*A*Syst.

- Training manual for citizen volunteers assisting in source water assessments and conducting public outreach and education.

- Support in developing public outreach strategy.

- Assistance in developing final assessment results and pollution prevention strategies for water supply consumers.

- Incorporation of assessment results and recommendations into future Cooperative

Extension workshops for municipal audiences and Home*A*Syst residential pollution prevention programs.

- Presentation of results to town officials /public in each assessment area.
- Assistance in summarizing assessment results in user-friendly format for water supply consumers.

Project Outcome Indicators

We have developed an evaluation tool for the RI Home*A*Syst Program to measure and document program outcomes. It consists of pre- and post-testing program participants including those who attend our multi-session volunteer training program and those who attend a three-hour community workshop. This tool measures adoption of best management practices, changes in behavior and knowledge gained. We will continue with this method of evaluation for this project. Outcomes include:

Best Management Practices Adopted

- Number of people conducting homesite assessments to determine risks to source water supplies.
- Number of on-site septic systems inspected and pumped in source water areas.
- Number of home heating fuel storage tanks tested and/or removed.
- Number of advanced treatment on-site septic systems installed in source water areas.
- Number of people adopting sustainable home landscaping practices.
- Numbers and types of stormwater best management practices installed.
- Number of people adopting non-toxic alternatives to household hazardous waste.
- Number of people adopting proper disposal technique for household hazardous waste.
- Number of people installing water conservation devices in their home.

Knowledge Gained

As a result of the volunteer training program, participants will:

- Be able to define a watershed, basic hydrologic functions, and the difference between nonpoint and point source pollution threats to surface water reservoirs and groundwater resources. They will be able to identify and provide examples of nonpoint and point sources of pollution and give specifics for the areas in which they are working.
- Be able to apply the RI Home*A*Syst risk assessment method in the project areas. They will be able to communicate this method to others in outreach activities and educational workshops.
- Be able to define best management practices for residential pollution prevention and

recommend practices to the public. They will learn to apply the ways in which to communicate this knowledge to audiences within the project areas.

- Have the resources and knowledge to conduct assessments in the watersheds and wellhead areas of the state's largest public drinking water supplies.

PROJECT PARTNERS AND RESPONSIBILITIES

This project will be coordinated with existing water supply protection efforts through the DOH SWAP Technical Review Committee, the Public Advisory Committee, and local advisory committees to be established for each major water supply evaluated through the Tier 2 assessment.

RI Department of Health

RI Department of Health will provide oversight to ensure coordination between URI tasks with existing programs. RI DOH shall provide to URI CE a final list of WHPAs and surface water supplies to be evaluated using the Tier 2 assessment procedure. RIDOH will coordinate the local advisory committee and will participate in the volunteer training program and community outreach workshops.

Local Advisory Committee

The local advisory group will oversee and direct the inventory and related public education efforts. Responsibilities of this group will include:

- Review project scope and data needs
- Review current land use maps and make recommendations for updating based on local knowledge. This task may be completed with assistance of citizen volunteers organized through RI Home*A*Syst.
- Provide future land use map or zoning map for build out analysis, or provide assistance in delineating zoning boundaries on current land use map.
- Review and comment on draft assessment products.
- Identify realistic and locally acceptable stormwater and wastewater management practices for analysis of the comparative effectiveness of these methods in minimizing pollutant inputs.
- Provide guidance in preparing water source protection recommendations.
- Provide guidance in summarizing assessment results in a user-friendly format for local officials, water users, residents, and others audiences.
- Assist in organizing and publicizing public meetings with town officials and the public to present and discuss assessment results.

Water supplier and /or municipality

The water supply company will assist in organizing the local advisory group. In addition to participating in this group the water supply company and/or municipality will:

- Identify water quality concerns and management issues in the water supply study area.
- Provide local information and data where available.

Appendix 10. MANAGE Program from the University of Rhode Island Cooperative Extension Service

MANAGE is a watershed assessment tool using computer-generated maps to evaluate pollution risks of land use and landscape features. MANAGE evaluates the cumulative effects of current land use, Future development, and pollution management practices on valuable water resources. Designed as a decision support system, MANAGE generates site-specific information needed to direct management actions. It has been developed specifically for use in Rhode Island and is tailored to southern New England characteristics. It has been tested and successfully applied in several RI communities.

MANAGE Functions:

1. Identifies pollution "Hot-Spots"— areas where natural features and high intensity land uses together increase risk of nutrient movement to aquifers and surface waters.

2. Compares the effects of existing and future LAND USE patterns on water resources:

   · Freshwater lakes and wetlands

   · Groundwater aquifers

   · Coastal embayments

3. Evaluates effectiveness of stormwater and wastewater management practices in reducing pollution risk.

Data Sources

The Rhode Island Geographic Information System (RIGIS) is the most extensive, high-resolution database assembled for any large area. MANAGE takes full advantage of this powerful database by using RIGIS coverages, accessed through the Environmental Data Center, as the primary source of data for the assessment.

Verification and Enhancement of land use data

RIGIS land use provides an initial estimate of land use density and number of housing units. This estimate is refined using local data.

· Current land use is updated using local input, US Census, and other sources.

· Build out analysis is performed using zoning or future land use map.

· Parcel-based analysis is conducted where digital maps are available.

Hot Spot Mapping

We start with the premise that certain high-intensity land uses are more likely to generate pollutants that others. The risk that pollutants generated will actually reach groundwater or flow into nearby streams and ponds depends on soils and proximity to receiving waters.

Using four functional soil (hydrologic) groups, "high-risk soils" are identified based on the potential for precipitation to seep into groundwater or to runoff the surface.

The resulting overlap of high-intensity land uses and high-risk soils quickly highlights the most serious nonpoint pollution sources. This "hot-spot" analysis efficiently narrows down potential problem areas for follow-up field investigation, targeted nonpoint education, or pollution prevention.

Nutrient Loading

The nutrient loading component of MANAGE calculates nitrogen and phosphorus inputs as one measure of pollution risk. Because water reaching municipal wells represents a mix of various travel times and sources, the nutrient concentrations calculated for the groundwater recharge percolate and to surface runoff should not be expected to match monitored water quality samples. Rather, the predicted nutrient concentrations should be viewed as one of many indicators of watershed health.

MANAGE output includes hydrologic budget and surface and groundwater loading for phosphorus and nitrogen. It also allows modeling of current and future land use scenarios using a variety of best management practices.

Watershed Indicators

Land use and soils data generated by the assessment are summarized in terms of potential for cumulative impacts to wetland water quality and generalized ecosystem health. Example indicators include occurrence of high intensity land use, percent impervious cover, percent forest land, and predicted nutrient inputs. These indicators provide a means to track watershed risks and evaluate the change in pollution potential under different land development or management scenarios.

MANAGEment Actions

The purpose of the MANAGE assessment is to identify effective steps to protect local water resources and to direct management actions. In each watershed where MANAGE has been applied, communities are using results to strengthen groundwater protection regulations, manage on-site wastewater systems, control land disturbance, and expand public education on resource protection.

MANAGE has been applied in the Town of New Shoreham; the Hunt-Potowomut watershed in cooperation with North Kingstown, East Greenwich, Warwick; by students of the URI Graduate Program in Community Planning in Green Hill Pond, located in South Kingstown and Charlestown; and in the Pawcatuck watershed, focusing on the Queens River subwatershed in the Town of Exeter.

Applying MANAGE - A Partnership between communities and URI Cooperative Extension

MANAGE is part of the URI Cooperative Extension's educational and technical assistance to Rhode Island communities. Through the Municipal Watershed Program, URI faculty, water quality specialists, and Coastal Fellow interns provide scientific expertise to community leaders and others to help integrate community development needs with local water resource protection. Coordination between URI and local decision-makers in applying MANAGE also ensures that realistic management practices are evaluated and data generated is directly useful for management decisions.

We offer:

- MANAGE analysis in partnership with communities and other groups interested in evaluating cumulative effects of nonpoint pollution and future risks of development on a watershed scale.

- Follow-up assistance in taking action to protect or restore water quality.

- Related support programs:

  - Home*A*Syst residential pollution prevention education
  - On-Site Wastewater Training Center training and technical assistance.
  - Watershed Watch scientist-led citizen monitoring.
  - ArcView Training and Geographic Information System development in cooperation with the URI Environmental Data Center.

MANAGE was developed by Dorothy Q. Kellogg, Lorraine Joubert, Dr. Arthur Gold, and James Lucht in cooperation with Dr. Peter August and the staff of the URI Environmental Data Center.

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Appendix 11 Source Water Supply Susceptibility Rating

URI Cooperative Extension

Background

The Source Water Assessment Program, or SWAP, was established to identify and assess contamination threats in watersheds and wellhead protection areas of public water supplies. In conducting source water assessments, the Rhode Island Department of Health will:

1. Delineate wellhead protection areas providing recharge to groundwater supplies (using existing boundaries or refining delineations where needed);

2. Inventory potential sources of contamination to water supplies;

3. Assess the risk associated with each potential source of contamination, rank the threats within each protection area, and determine the overall susceptibility of the water source; and

4. Make results of the assessments known to the suppliers, consumers of public water, town officials, and others.

Objectives

In this document we outline a system to evaluate the overall susceptibility of a public water supply to contamination. This method is applied to the full area delineated as a water supply reservoir watershed or a wellhead protection area contributing recharge to a groundwater supply. It incorporates basic inventory data on potential sources of contamination and the risk of contamination associated with these sources. By taking into account natural features of the source water area, it considers both the vulnerability and susceptibility of the supply. Risks related to landscape features and land use include: land use activities, known pollution sources, location of high intensity land use on soils most likely to promote pollutant movement to either groundwater or surface waters, and proximity of potential contaminant sources to wells and reservoirs. The risks associated with the characteristics of the water supply itself and the quality of the raw water are also summarized. In designing this rating system we have taken the following approach:

1) Assess pollution risks to each source water area using a basic, uncomplicated system that addresses a variety of risk factors meaningful to non-technical audiences.

2) Summarize results for each source water area using general categories from low to extreme; avoid numerical rankings that might imply greater accuracy than possible.

3) Use existing information from the Rhode Island Geographic Information System and other sources that are readily available for

all source water assessments, while allowing for updated and corrected data to be entered as available;

4) Distinguish between naturally occurring and human-related risks to provide information needed to guide management actions.

5) Apply the method consistently for all supplies to allow comparison among source water areas within one Town or within the State.

6) Display results in an easily understood format for water suppliers, local officials, consumers, and others.

Method

To address differences between surface reservoirs and groundwater supplies, the method is divided into two parts, with Part 1 used in ranking wellhead protection areas, and Part 2 for surface reservoirs. This ranking system will be tested and revised using data from wellheads and reservoirs representing a range of land use and landscape features occurring in Rhode Island source water areas.

The source of data is the Rhode Island Geographic Information System (RIGIS) unless otherwise specified.

Use numerical values to sum: LOW = 0; Med = 5; High = 10; Extreme = 25 ; Establish range of values for each rating, and assign final ranking given placement within range.

Interpreting Results

This ranking system provides one relatively simple measure of susceptibility that can be consistently applied to source water areas throughout Rhode Island communities. As presented here, it does not integrate additional site-specific information that may be collected and evaluated through in-depth assessment of major community wells and other public supplies. For example, the ranking system uses one soil characteristic – the ability of soils to allow infiltration, using four broad categories. A number of other factors, such as water table depth, presence of highly restrictive layers, erodible soils typically evaluated in more in-depth analysis are not, but could be, considered. Land-use and point-source inventory data will be modified based on ground-truthing of existing coverages.

Reducing susceptibility of the water source to one final score may be useful as an overall summary and for comparing source water areas, but in the process valuable information is lost. A low susceptibility score does not mean a wellhead is not at risk. Even a single source can contaminate a supply, even though the total score is low. Whenever pollution risks are identified, and especially in critical areas on soils conducive to pollutant movement, or in close proximity to wells and receiving waters, follow-up is needed to identify the source and ensure appropriate management practices are in place. We have tried to minimize the potential for masking

data by keeping separate scores for different types of risks, and by making the full rating system readily accessible to show factors that contributed to the final score. Stacked bar charts have proven to be particularly useful in this regard.

Part 1 Susceptibility Ranking for Wellhead Protection Areas							
	RISK INDICATOR	**MEASUREMENT**	**RATING**				**RANK**
			LOW	**MEDIUM**	**HIGH**	**EXTREME**	
1	Wellhead Protection area (WHPA) land use.	High intensity[1] land use (percent) throughout the WHPA.	< 10%	≥ 10–15%	≥ 15–25%	≥ 25%	1. List rating
2	Wellhead Protection area (WHPA) land use on rapidly permeable soil.	High intensity land use (percent) located on highly permeable soils[2] throughout the WHPA.	None	< 5%	≥ 5– 15%	≥ 15%	2. List rating
3			***Land use risk***				**3. Sum of 1 and 2.**
4	Known pollution sources within critical well	Mapped point sources within inner protective well radius (400' or 200'). Data source: inventory data.	None			Presence of one or more sources	4. List

[1] High intensity land use includes those land use categorized as either very high or high risk by URI Cooperative Extension, to include (with RIGIS codes): Industrial (130), Commercial (120, 147, 150), Junkyards (145), Transportation (141, 142, 143), Institution (144, 170), Residential >4 du/acre (111, 112), and Cropland (240, 220, 230).

[2] Highly permeable soils selected are those categorized as Hydrologic Group A in the Soil Survey of Rhode Island. Other soils may have excessively permeable subsoils that also present a risk to groundwater contamination.

	protection radius.						rating
5	Known pollution sources within wellhead protection area.	Mapped point sources within wellhead including inner radius. Data source: inventory data.	None	[3]	[3]	[3]	5. List rating
6			**Known pollution source risk**				**6. Sum of 4 and 5.**
7			**Watershed land use and landscape features risk**				**7. Sum of 3 and 6.**
8	Aquifer characteristics.	USGS vulnerability rating (based on aquifer type and depth).	Bedrock [4] well.	Deep sand and gravel well.	Shallow sand and gravel well.		8. List rating
		Other feature?					
9			**Aquifer characteristics risk**				9. List 8.
10	Well water quality	History of contaminant detects within previous five years (presence/absence for organic solvents, hydrocarbons, pesticides or metals).	None		≤ ½ MCL	> ½ MCL	10. List rating

[3] Risk from point sources throughout the WHPA will be assigned based on number and type of source. Potential sources such as underground storage tanks may be classified as moderate risk, with known point sources such as leaking underground storage tanks classified as high risk.

[4] Bedrock wells have generally lower risk of contamination than those located in outwash expect that risk of contamination by radionuclides or fluoride is greater. (USGS)

11		History of bacteria detects within previous five years.	None		Minor detection with cause identified and corrected.	Other detection	11. List rating
12		Nitrogen concentration as indicator of human influence	< 1 mg/l	1 – 2 mg/l	2 – 5 mg/l	> 5mg/l	12. List rating
13			**WELLWATER QUALITY RISK**				**13. Sum of 10 –12.**
14			**FINAL SUMMARY RATING**				**14. Sum of 7, 9 and 13.**

Part 2 Susceptibility Ranking for Surface Water Reservoirs							
	RISK INDICATOR	**MEASUREMENT**	**RATING**				**RANK**
			LOW	**MEDIUM**	**HIGH**	**EXTREME**	
1	Watershed land use	High intensity[1] land use (percent) throughout the watershed.	< 10%	≥ 10–15%	≥ 15–25%	≥ 25%	1. List rating
2	Watershed land use on runoff-producing soils.	High intensity land use (percent) located on slowly permeable soils[5] with seasonal high water table throughout the wellhead.	None	< 5%	≥ 5– 15%	≥ 15%	2. List rating
3			***Watershed land use risk***				**3. Sum of 1 and 2**
4	Watershed land use within critical buffer.	High intensity land use (percent) located on within 200' buffer of reservoir and tributaries.	None	< 5%	≥ 5– 15%	≥ 15%	4. List rating

[5] Slowly permeable and seasonal high water table soils selected are those categorized as Hydrologic Group C and D in the Soil Survey of Rhode Island. Water table depth varies from 3.5 feet to water at surface; permeability ranges from x – y , with 0.2 minutes per inch in restrictive layers characteristic of basal till soils.

5			***Watershed and Buffer land use risk***				**5. Sum of 3 and 4.**
6	Known pollution sources within critical buffer.	Mapped point sources within 200' buffer to reservoir and tributaries.	None			Presence of one or more sources	6. List rating
7	Known pollution sources within watershed	Mapped point sources within watershed including 200' buffer.	None	[6]	[6]		7. List rating
8			***Known pollution source risk***				**8. Sum of 6 and 7.**
9			**Watershed land use and landscape features risk**				**9. Sum of 5 and 8.**
10	Watershed and reservoir characteristics	Trophic status[7] as indicator of human influence	Oligo-trophic	Meso-trophic	Meso/ Eutrophic	Eutrophic	10. List rating
11		Vulnerability based on reservoir depth, size (flushing rate where available), and shoreline configuration.	Well flushed	Moderately well flushed	Poorly flushed	Restricted flushing	11. List rating

[6] Risk from point sources throughout the watershed will be assigned based on number and type of source. Potential sources such as underground storage tanks may be classified as moderate risk, with known point sources such as leaking underground storage tanks classified as high risk.

[7] Indicators of trophic status to be based on phosphorus concentration, Carlson's trophic index, and/ or frequency and severity of algal blooms.

12		Compliance with water quality criteria[8]	Full compliance	Threatened	Seriously threatened	Impaired	12. List rating
13			**Watershed and reservoir characteristics risk**				**13. Sum of 10, 11 and 12.**
14	Outflow quality	History of contaminant detects within previous five years (presence/absence for organic solvents, hydrocarbons, pesticides or metals).	None		≤ ½ MCL	> ½ MCL	**14. List rating**
15		History of bacteria detects within previous five years.	None		Minor detection with cause identified and corrected.	Other detection	**15. List rating**
16			**Outflow quality risk**				**16. Sum of 14 and 15.**
17			**FINAL SUMMARY RATING**				**17. Sum of 9, 13 and 16.**

[8] Based on DEM assessment of watershed tributaries and reservoir; tributary and reservoir monitoring data will be considered where available.